THE CHEMICAL AND PHYSICAL PROPERTIES OF KLUAY KHAI FILM

WILAILAK Suanmali[1,a], VACHIRAYA Lioatrakoon[2,b],
YUPIN Phoondee[3,c]

[1] Faculty of Science and Technology, Kamphaeng Phet Rajabhat University, Kamphaeng Phet, Thailand

[2]Rajamangala University of Technology Suvarnabhumi, Phra Nakhon Si Ayutthaya, Thailand

[3]Rajamangala University of Technology Suvarnabhumi, Phra Nakhon Si Ayutthaya, Thailand

[a]<aewilailak_s @hotmail.com>, [b]<vachirayak@hotmail.com>, [c]<phoondee@hotmail.com>

Keywords: Physical Properties of film, Kluay Khai

Abstract. This research uses of Musa (AA group) "Kluay Khai" to making the film and study the properties of film. The Kluay Khai filmv (KKF) has a yellow light brown with small black spot all the film. KKF were smooth, clear, flexible, tear-hard, brittle and little smell of bananas. The thickness of KKF was in the ranged of 0.38 to 0.67 mm from 6% of Kluay Khai starch (KKS) and 40 % glycerol as its minimum thickness. The KKF with 10% of KKS and 60 % sorbitol as its maximum thickness. The % of KKS, type and % of plasticizes, influence to the tensile strength and elongation of the KKF. The KKF can prevent damage from oxygen as well with water vapor permeability water was increased when glycerol or sorbitol was increasing. The kluay khai film contained sorbitol present less of water vapor permeable than glycerol.

1. Introduction

Banana is considered as one of the important foods of the world, which is the fourth after rice, wheat and dairy, respectively. But banana is the only fruit that is well known around the world and popular consumption [1]. Kluay Khai is popular in general consumption, especially ripe stage because of its good taste, sweet, soft and not too big size. In the past, Kluay Khai was cultivated for domestic consumption it becomes one of the important economic crops of the country. Thus, it was extended cultivation for exporting to foreign countries because it can be considered as a potential fruit in high output. It can be stored at low temperatures for a long time that is convenient to export. In production, it can be produced for commerce throughout the year [2]. In Kamphaeng Phet province, Thailand, the Kluay Khai was the most popular species for growing, because it can be developed in humus sandy soil, loose soil with good drainage, abundance of water and no flat land. Kamphaeng Phet province has appropriate geographical features and climate as a result; Kamphaeng Phet. Kluay Khai is characterized by sweet taste, thin crust and tight texture different from other areas. So, it is considered that Kamphaeng Phet province was important source of Kluay Khai product of the country [3] Edible film is defined as a thin layer, which used as a food ingredient and can be consumed together with food, and applied on coating or wrapping products as a paper or

plastic film. Particular property is a resemble barrier between food and outer contactable, functions to prevent water vapor permeability, against oxygen and volatile flow, and resist to acceptable solubility. Thus, an edible composite coating is an effective way to extend the shelf life of food products. In general, films base on polysaccharides, proteins and fats, which is edible film or coating is interested. However the films making from natural substances such as polysaccharides, proteins and fats are not strong structure compared with plastic films (such as polyethylene and polypropylene), but they can be used as secondary packaging to reduce the amount and type of materials used in for packaging. In Thailand, banana is had been cultivate in all areas which contains most starch composition. The structure of banana film is natural polymer that easy to break down from environmental mechanism damage, solubility, and low cost. So, edible film development from Kluay Khai banana is good, which in used to enhance post-harvest to agricultural products of the country. Additionally, it has not reported on properties of Kluay Khai banana film which the research data will be useful for further application in the food industry. This study is observed feasibility on film production using banana starch as a crude material for formation, this can be used further.

2. Methodology

2.1 Preparation of Kluay Khai film.

2.1.1 The 2 type of Kluay Khai film were prepare follow this: Film 1; the Kluay Khai film was prepared with 3 levels of Kluay Khai starch (6, 8 and 10% (w/v)) containing 3 levels of glycerol (40, 50 and 60% by starch weight). Film 2; The Kluay Khai film was prepared with 3 levels of Kluay Khai starch (6, 8 and 10% (w/v)) containing 3 levels of sorbitol (40, 50 and 60% by starch weight).

2.1.2 The physical and chemical property as were evaluated The Kluay Khai film were tested by rape of the dry banana with Kluay Khai film compare with unwrapped and, then stored for 28 days under room temperatures. The physical and chemical property of Kluay Khai film were evaluated of the appearance, moisture, color (L*, a* b*), thickness, tensile strength, elongation, oxygen permeability and water vapor permeability with performed 3 replicates. The data is analyzed by completely randomized design (CRD) test. This test was performed in every 7 days consisted with: the appearance, taste, smell, crispness, color and color values (L *, a* b *), with performed 3 replicates. The data of were compared the difference between statistically significance, analysis of variance (ANOVA) and means value by Duncan's New Multiple Range Test at 95% confidence level.

3. Results and Discussion

3.1 Appearance of Kluay Khai film

Kluay Khai film as shown in figure 3, was found that a yellowish-brown with small black spots caused by banana seeds scattered throughout the film. The Kluay Khai film was smooth, clear, flexible, tear-resistant, not brittle, and had a slight banana starch. And when increasing the amount of banana starch, the color of the Kluay Khai film was darker. But when the plasticizer content increased, the film was become more transparent. The Kluay Khai film contained with glycerol was darker than the sorbitol.

Fig 1. Appearance of Kluay Khai film

3.2 Moisture content (%)

The moisture of Kluay Khai film was shown in Table 1. The % of Kluay Khai starch, plasticizer type and % of plasticizer were influenced on film moisture content ($p \leq 0.05$) that was between 27.78-37.44%. The moisture was increase when % of Kluay Khai starch was increase. [4]. Which the Kluay Khai film used glycerol as a plasticizer present more moisture that sorbitol.

Table 1. Moisture content (%) of Kluay Khai film

Types	plasticizers (%)	Moisture content		
		Kluay khai starch (%)		
		6	8	10
glycerol	40	28.88±0.16	30.82±0.38	31.85±0.40
	50	32.09±0.26	33.34±0.56	35.36±0.21
	60	34.16±0.79	37.18±0.42	37.44±0.16
sorbitol	40	27.78±0.00	28.14±0.34	29.46±0.92
	50	30.71±0.55	32.44±0.25	33.47±0.90
	60	31.22±0.69	33.55±0.21	35.41±1.93

3.3 The L *, a *, b * of Kluay Khai film

The L* values was between 61.87-73.57. The color value of a* was between 3.37-6.47 and the color b* was between 9.49-25.97. When increasing the amount of kluay khai starch, L* values was decreased, while the color values of a* and b* were increased. Kluay khai starch was yellow dark, because it may be brown coloring reaction during the process of making Kluay Khai starch. Thus, the film was darker when the amount of Kluay Khai starch was increased. The comparison of the color values of Kluay Khai film with glycerol and sorbitol found that the color of Kluay Khai film containing sorbitol was slightly yellowish and clearly than use glycerol film as a plasticizer.

3.4 The thickness of Kluay Khai film

The thickness of the Kluay Khai film was shown in Table 2. The Kluay Khai film containing with 6% Kluay Khai starch and 40% glycerol had the lowest thickness of 0.38 mm. and 10% of Kluay Khai starch and 60% of sorbitol had the highest thickness of 0.67 mm. with 95% confidence level ($p \leq 0.05$). This result was indicated that the thickness of film was increased when the % of Kluay Khai starch and the % of sorbitol were increased. The thickness of the Kluay Khai film with sorbitol was higher than glycerol.

Table 2. Thickness of Kluay Khai film

Types	Plasticizers (%)	Thickness (mm)		
		Kluay Khai starch (%)		
		6	8	10
glycerol	40	0.38±0.03	0.5±0.01	0.59±0.01
	50	0.42±0.01	0.54±0.01	0.6±0.01
	60	0.43±0.01	0.57±0.01	0.62±0.01
sorbitol	40	0.4±0.01	0.51±0.01	0.61±0.01
	50	0.43±0.01	0.55±0.02	0.64±0.01
	60	0.46±0.01	0.59±0.02	0.67±0.01

3.5 Tensile strength and elongation

The tensile strength and elongation of Kluay Khai film was shown in Table 3. The % of Kluay Khai starch, the type and % of plasticizer influenced to the tensile strength and the elongation ($p \leq 0.05$), The tensile strength and elongation of Kluay Khai film were in the range of 0.41-1.85 MPa and 45.77 - 125.19%, respectively. The tensile strength was decreased when increasing the % of Kluay Khai starch that due to the structure consist of amylose with a linear glucose connection while the elongation was increased. The tensile strength and elongation were increased when increasing % of glycerol or sorbitol which the molecules of plasticizer in the polymer chains was reduces the the polymer structure has more spaces and can be moved freely. Thus, the Kluay Khai film was improved flexible and strength.

Table 3. The tensile strength and elogation of Kluay Khai film.

Types	Plasticizers (%)	Tensile Strength (MPa)		
		Kluay Khai starch (%)		
		6	8	10
glycerol	40	1.26±0.28	1.15±0.34	0.88±0.07
	50	0.90±0.05	0.72±0.27	0.58±0.05
	60	0.52±0.11	0.50±0.09	0.41±0.25
sorbiyol	40	1.85±0.25	1.28±0.34	0.83±0.17
	50	0.91±0.10	0.74±0.16	0.74±0.20
	60	0.75±0.21	0.53±0.15	0.73±0.17
		Elogation (%)		
glycerol	40	1.26±0.28	1.15±0.34	0.88±0.07
	50	0.90±0.05	0.72±0.27	0.58±0.05
	60	0.52±0.11	0.50±0.09	0.41±0.25
sorbitol	40	50.52±0.60	45.77±0.21	61.07±0.58
	50	49.81±0.74	54.75±0.56	75.34±0.86
	60	77.83±0.49	91.08±0.52	91.38±0.83

3.6 Oxygen permeability of the film was used

The Oxygen Permeability of Kluay Khai i film using the peroxide value (PV). The experiment showed that the % of Kluay Khai starch, the type and % of plasticizers were significantly ($p > 0.05$) influenced to oxygen permeability on the film. The Oxygen Permeability of Kluay Khai film was 2.04-2.49 meq O2/kg oil, indicated that the Kluay Khai film can prevent products from degradation process by oxygen, such as the products with high fat contents (Table 4).

Table 4. Oxygen permeability of Kluay Khai film.

Types	Plasticizers (%)	Oxygen permeability ($meqO_2$/kg oil)		
		Kluay Khai starch (%)		
		6	8	10
glycerol	40	2.10±0.01	2.17±0.00	2.23±0.02
	50	2.23±0.01	2.18±0.05	2.42±0.02
	60	2.31±0.01	2.30±0.03	2.43±0.03
sorbitol	40	2.55±0.02	2.04±0.10	2.25±0.09
	50	2.57±0.02	2.23±0.02	2.46±0.02
	60	3.07±0.03	2.59±0.04	2.49±0.02

3.7 The water vapor permeability of kluay khai film (WVP).

The water vapor permeability of Kluay Khai film was shown in Table 5, the water vapor permeability of Kluay Khai films was in range 26.88-38.80 g•mm/m2•day•kPa, for glycerol as plasticizers the water vapor permeability was decreased when increasing amount of the Kluay Khai starch because Kluay Khai starch supports the structure of the film to denser. The water vapor permeability was increased when glycerol or sorbitol was increasing. Which water vapor permeability was increased may affect to the molecular of plasticizer was reduces then the force between the polymer chains, which structure of film has more spaces and water vapor can spread through the film highly [5]. Furthermore, the Kluay Khai film contained sorbitol present less of water vapor permeable than glycerol.

Table 5. The water vapor permeability of Kluay Khai film

Types	Plasticizers (%)	water vapor permeability g·mm/m2·day·kPa		
		Kluay Khai starch (%)		
		6	8	10
glycerol	40	26.88±1.20	31.95±0.06	32.68±2.06
	50	30.75±0.66	35.21±0.54	34.18±0.46
	60	34.55±0.10	38.80±0.17	36.80±0.74
sorbitol	40	30.04±0.03	25.92±0.08	27.26±0.06
	50	35.96±0.02	32.81±0.01	33.74±0.05
	60	35.19±0.02	39.52±0.01	34.87±0.01

4. Conclusion

This study investigated the physical and chemical preperties of Kluay Khai film. The Kluay Khai film was a yellow-brownish, small black spot, smooth, clear, flexible, not brittle, and had a slight Kluay Khai starch. The color of Kluay Khai film containing sorbitol was slightly yellowish and clearly than use glycerol film as a plasticizer. The thickness of film was increased when the % of Kluay Khai starch and the % of sorbitol were increased. The thickness of the Kluay Khai film with sorbitol was higher than glycerol. The tensile strength and elongation were increased when increasing % of glycerol or sorbitol. The Oxygen Permeability of Kluaykhai film was 2.04-2.49 meq O2/kg oil that Kluay Khai film can prevent products from degradation process by oxygen. The Kluay Khai film contained sorbitol present less of water vapor permeable than used glycerol as a plasticizer.

Acknowledgements

This research was financially supported by Environmental Science Program, Rajamangala

University of Technology Suvarnabhumi, Faculty of Science and Technology, Kamphaeng Phet Rajabhat University are gracefully acknowledged.

References

[1] S. Kamolsak. Economic analysis of the production and marketing of bananas, eggs Kamphaeng Phet province. Master of Science thesis. (Agricultural Economics), Department of Agricultural Economics. College Kasetsart University (2006).

[2] J. Bussara. Cost-benefit analysis of Golden Banana production in Tak Province, Graduate School, Chiang Mai University (2008).

[3] B. Phadet. Development of banana production of farmers, Sa Kaeo District, Kamphaeng Phet Graduate School ,Rajabhat University, kamphaeng Phet. (2011).

[4] R.Sothornvit and P Rodsamran. Effect of a mango film on quality of whole and minimally processed mangoes. Postharvest Biology and Technology. 47: 407-415 (2008).

[5] L.Yang, and A.T Paulson. Effects of lipids on mechanical and moisture barrier properties of edible gellan film. Food Research International 33(7): 571– 578 (2000).