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Effect of Ethylene Curing on the Physical Properties and Nutritional Contents of Thai's Banana (Kluai Namwa)

Lalita Siriwattananon [1*] and Suwanan Yodsarn[1]

[1]Department of Food Science and Technology, Faculty of Agricultural Technology,

Rajamangala University of Technology Thanyaburi (RMUTT), Thailand

*Corresponding email: Lalita_s@rmutt.ac.th

Abstract. Banana is one of energy source fruit which growth all over Thailand. As a shortage shelf life, most of bananas are cut while it still green in order to maintain its physical quality and also the damage while transporting. Practically after cutting banana, there are two different ways of ripeness; naturally ripe and gas curing. Both ways may affect to the quality of banana differently. So, this research interest has paid attention to compare the change of physical properties, potassium and magnesium contents in bananas from different ripeness methods. Three maturation phases of banana were applied as an unripe, naturally ripe and curing. Thai Banana of Kluai Namwa (Musa ABB cv. Kluai "Namwa") was used in this study. Kluai Namwa was cultivated after 15 weeks (when it still green), and then divided into two groups. The first one was kept it naturally at the room temperature until it ripe, the second one was cured using ethylene gas for 24 hours in order to make it ripe. The results showed that there were a significant different ($p \leq 0.05$) in color and hardness of bananas, as well as the potassium and magnesium contents of bananas from two different ripeness ways. The potassium content in cured Kluai Namwa showed higher than that in unripe and naturally ripe Kluai Namwa of 383.02, 373.20 and 324.50 (mg/100g), respectively. In addition, the unripe Kluai Namwa showed the highest magnesium content compared to cured Kluai Namwa and naturally ripe Kluai Namwa of 37.12, 35.41 and 27.08 (mg/100g), respectively. According to the results, it was recommended that curing method may help to increase the potassium and magnesium contents in ripe banana.

Keywords: Banana, Curing, Potassium, Magnesium

1. Introduction

Banana (Kluai Namwa) (*Musaceae* spp.) is a biennial plant, tall trees above the ground with a round shape, with a leaf cover overlaid with large green leaves. The nature of the banana flowers flowering at the end of a bouquet of hanging head 1-2 long elbows, which is called a pillow or a neck. When mixed, it will result in the appearance of the fruit will be attached to a panel called combs stacked several combs called the bunch when it is soft, the shape is quite square, the result is long, thick and green. Banana (Kluai Namwa) consists of Potassium and Magnesium [2] which a mineral that is essential to the body. It plays an important role in helping the normal functioning of the body, such as the nervous system and muscles. Potassium helps regulate electrolyte balance and acid-base balance in the body. Prevent acid

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over (hyperacidity) and also help control high blood pressure and reduce the risk of cardiovascular disease [1] [8].

Normally, people consume bananas when it turned yellow (ripe) but it has a shortage shelf life after that. Most of bananas are cut while it still greens in order to maintain its physical quality and also the damage while transporting. Practically after cutting banana, there are two different ways of ripeness; naturally ripe and gas curing. Both ways may affect to the quality of banana differently. In Thailand, there is a higher demand in banana consumption as well as production. When the production over consumption demand, a lot of bananas remain as a waste which affected an environmental problem. It is important to increase the value-added of banana as well as to decrease the banana waste. So, this research interest has paid attention to compare the change of physical properties, potassium and magnesium contents in bananas from different ripeness methods.

2. Materials and Methods

2.1. Banana material

Banana (Kluai Namwa) used in this study was collected from banana plantation field in Pathum Thani province, Thailand. Banana was harvested while it green (15 weeks after stabbing banana blossom) as show in Figure 1. After harvested, banana was transported (under room temperature condition) to the laboratory and used for the study immediately. Banana then divided into two groups and put into a paper box. Then the first one was kept it naturally at the room temperature, and the second one was cured using ethylene gas for 24 hours in order to help it turned yellow faster. After 24 hours curing, ethylene was taking out and two groups of bananas were continue kept it at the room temperature for 4 more days. Then, banana samples were taking for physical and chemical analysis.

Figure 1. Green banana used in the study

2.2. Physical analysis

Analytical method for color

Colorimetric measurements spectrophotometer; Model 3500d CIE L* a* b* system was used to measure the color of banana samples [3].

Analytical method for Firmness

To measure the firmness. Fruit pressure tester (Penetrometer Effegi) with 0.95 cm diameter probe and pressed on 0.5 cm deep banana meat converted the labor force from kilogram to newton (1) [5].

$$\text{Firmness (kg)} \times 9.807 \qquad (1)$$

2.3. Chemical analysis

Analytical method for potassium and magnesium

Banana samples were cut and used for the Flame Atomic Absorption Spectrometer (FAAS) analysis. Sample was mixed with 10 ml HNO_3 and heat up at 31°C for 10 minutes. Then adjust volume to 100 ml in volumetric flask with deionized (DI) water to measure potassium and magnesium by FAAS technique [6] [10].

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Statistical analysis

The data obtained from the study were analyzed variance by using a software Complete Randomized Design (CRD). In addition, mean was analyzed by applying Duncan's New Multiple Range Test (DMRT) with level of significance at $P \leq 0.05$.

3. Results and Discussion

The results of physical properties as well as the potassium and magnesium contents of banana (Kluai Namwa) from difference experimental treatments (control, natural ripe, and ethylene curing) are as follow.

Color

According to the experimental results, color of bananas shows in Figure 2. The brightness (L*), the redness (a*), and the yellowness (b*) of bananas by the colorimetric measurement spectrophotometer show in Table 1.

Control Natural ripe Ethylene curing

Figure 2. Banana (Kluai Namwa) from difference experimental treatments

Table 1. The color of banana (Kluai Namwa) from difference experimental treatments

Treatment	Color		
	L^{*ns}	a^{*ns}	b^{*ns}
Control	**76.16±3.09**	**3.41±0.18**	**20.18±0.45**
Natural ripe	**65.83±0.83**	**4.27±0.29**	**28.32±1.67**
Ethylene curing	**74.29±2.84**	**2.66±0.09**	**19.53±0.19**

Remark: ^{ns} **means within the same row with vertical are no-significantly different (p>0.05)**

Firmness

Table 2 shows the firmness of banana (Kluai Namwa) from difference experimental treatments of control, natural ripe, and ethylene curing were 6.96 N, 2.94 N and 4.22 N, respectively. The result showed that curing using ethylene gas has effect to accelerate the ripening of banana (Kluai Namwa), which was consistent to similar research results [4] [9] [11].

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Table 2. The firmness of Banana (Kluai Namwa) from difference experimental treatments

Treatment	Firmness (N)
Control	**6.96±6.48[a]**
Natural ripe	**2.94±1.96[c]**
Ethylene curing	**4.22±3.15[b]**

Remark: [a-c] mean within the same row with vertical are significantly different ($p \leq 0.05$)

Potassium and Magnesium

Table 3 shows the potassium and magnesium contents of banana (Kluai Namwa) from difference experimental treatments by Flame Atomic Absorption Spectrometer (FAAS) technique. The potassium content of banana (Kluai Namwa) from difference experimental treatments (control, natural ripe, and ethylene curing) was 373.20 mg/100 g, 324.50 mg/100 g and 383.02 mg/100 g, respectively. The magnesium content of banana (Kluai Namwa) from difference experimental treatments (control, natural ripe, and ethylene curing) was 37.12 mg/100 g, 27.08 mg/100 g and 35.41 mg/100 g, respectively. The experimental results show the same tendency to various researches [1] [8] that banana has higher potassium content. Additionally, applying curing technique using ethylene gas resulted in increasing the amount of potassium and magnesium in banana significantly ($p \leq 0.05$). The fruit is associated with ethylene which unsaturated hydrocarbon molecule is C_2H_4, with a double bond. Ethylene is a gas produced by the metabolism of plant especially in the near-ripening stage, this gas is highly dispersed, which is responsible for stimulating the respiration process and making the resulting fruit near maturation faster. Therefore, bananas that are cured with ethylene gas will help maintain the properties and quantity of minerals than normal cooked [7]. Liu *et al.*, reported that ethylene production began to increase at 10 days after harvest with a sharp peak at 14 days, and then decreased rapidly. In bananas, ethylene is the dominant trigger for postharvest ripening [12]. In addition to Yong *et al.*, reported that increased tolerance of banana fruit pre-treated with propylene to low temperature-induced chilling was related to higher post-storage ethylene production rates [13].

Table 3 Potassium and magnesium contents of Banana (Kluai Namwa) from difference experimental treatments

Treatment	Potassium (mg/100g)	Magnesium (mg/100g)
Control	**373.20±[a]**	**37.12±[a]**
Natural ripe	**324.50±[b]**	**27.08±[b]**
Ethylene curing	**383.02±[a]**	**35.41±[a]**

Remark: [a-b] mean within the same row with vertical are significantly different ($p \leq 0.05$)

4. Conclusion

The experimental results showed that there were a significant different ($p \leq 0.05$) in color and firmness of banana, as well as the potassium and magnesium contents of banana from two different ripeness ways. The potassium content in cured banana (Kluai Namwa) using ethylene gas showed higher than that in control (unripe) and naturally ripe. According to the results, it was recommended that curing method using ethylene gas may help to increase the potassium and magnesium contents in ripe banana. So, what

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find out from this research might further develop to increase value-added and alternative healthy products from banana.

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