

## Effect of 1-MCP in Combination with Heat Treatment on Preservative Quality of Banana (Cv. Kluai Khai) Fruits

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### Abstract

Effect of 1-MCP in combination with heat treatment on preservative quality of 'Kluai Khai' banana fruit was investigated by fumigating fruits in 1-MCP for 2° hours at 22°C, after that fruits were continued heat treatment for 14, 18, and 22 hours at 42°C compared to fruits non treated (control) and fruits were fumigated 1-MCP only. The results showed that treatment of fumigating fruit in 1-MCP in combination with heat treatment for 22 hours could maintain a\* and L\* values and fruits did not show ripeness when compared to those fruits of the control and the other treatments for 13 days in storage. Furthermore, the quality of fruit expressed as total soluble solids content was not different when compared to fresh banana fruits.

**Keywords:** Kluai Khai, banana, 1-MCP, heat treatment

### Introduction

Banana is an economically important plant in the humid tropical lowlands, with year round fruit production. There are many banana cultivars grown commercially; however, only bananas with genome composition and ploidy AA (*Musa acuminata*, AA Group) namely 'Kluai Khai' in Thai, 'Pisang Mas' in Malaysia and Indonesia, 'Amas' in Philippine and 'Dai Hoang King' in Vietnam showed the most serious senescent spotting, while the others fewer less symptoms (Ketsa, 2000). 'Kluai Khai' bananas show peel spotting when the peel is just about as yellow as green, which coincides with optimum eating quality. As consumers might relate the spotting to overripe fruit, early spotting is considered undesirable, especially for export markets (Promyou, 2007).

Ripening of banana as a climacteric fruit is triggered by exposure to ethylene, and the ethylene concentration in the storage environment has a decisive influence on the ripening process. Banana ripening is an irreversible process, once the ripening has initiated it cannot be stopped. However, if bananas are treated first with an ethylene antagonist, they do not respond to exogenous ethylene applications before 7–12 days (Sisler, 2001). 1-MCP is a gaseous olefin binding to specific receptors for ethylene in the cell membranes, avoiding ethylene binding to proteins that will send signals associated with ripening. (Sisler, 2009) 1-MCP efficiency to delay changes associated with ripening depends on several factors like genotype, concentration, temperature of application and exposure time. (Blankenship, 2003) Using 1-MCP in fresh fruit and vegetable storage is considered to be a breakthrough in postharvest technology. Besides this, the interest in the postharvest use of heat treatment has been increasing. Heat treatments against pathogens may be applied to fresh harvested commodities by hot water dips, by vapour heat, by hot dry air or by a very short hot water rinse and brushing; there are new methods for replacing chemical treatment. Several technologies have been related success used alone or combined. For example, used various heat treatments in red grapefruit (Porat, 2000), delay the peel spotting in Sucrier banana. However, no research has been done to study the combined effect of applying 1-MCP with heat treatment on preservative quality of 'Kluai Khai' banana.

Therefore, the objective of this research was to evaluate the efficiency in bananas of 1-MCP applied alone or combined with a heat treatment to delay the ripening of 'Kluai Khai' banana during the storage period.

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## Materials and methods

### Plant material and treatments

'Kluai Khai' banana fruits in a farmer orchard of Kamphaeng Phet province were used in this research. Fruits were harvested at commercial maturity in the morning, and bunches of fruit were cut by hands and were placed in corrugated cardboard boxes to transport to the laboratory by a temperature-controlled truck (25°C).

In the laboratory, only undamaged fruits in state 3 (Figure 1) were selected to treat experiments and than fruits were cleaned in clorox solution before dipped in 0.2% cabendazim solution for 2 to 3 minutes. The fruits were then dewatered for 20 minutes for further treatments. Fruits were randomly selected for four experiments, and each experiment had 15 hands. The experiment design as follows.

(1) Fruits were fumigated with 1-MCP (1tablet/m<sup>3</sup>, Lytone Enterprise, inc. Taipei.) for 20 hours at 22°C.

(2) Fruits were fumigated with 1-MCP for 20 hours at 22 °C, after that treated in various time of heat treatment for 14, 18, and 22 hours at 42°C.

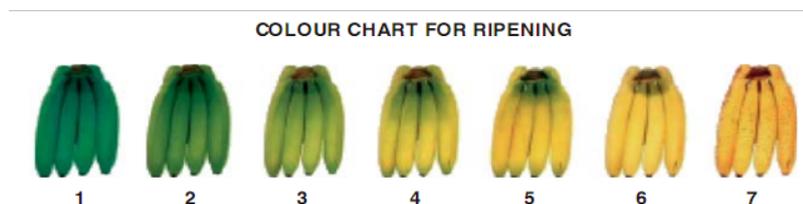
(3) The last group was the control or untreated fruits.

All treatments were stored in environmental chamber (Contherm global 5000) at 25°C, 85% ±2RH for checking quality in 2 day interval's analysis.

### Methods

The L\* and a\* values were measured by a colormeter (Konica Minolta, Japan). Total soluble content was investigated by a digital refractometer (Pal-1, Atago, Japan).

Statistical analysis was carried out by using SPSS version 13 and Duncan's multiple range tests to analyze the difference between treatments and control.



## Results and discussion

### Change in a\* and L\* values

The a\* value (greenness) of the peel of banana fumigated with 1-MCP in combination with various time of heat treatment compared to the control is shown in the Table 1. Overall, the a\* value tended to increase in all treatments and the control with the increasing of storage time. After 13 days in storage, the a\* value ranged between 5.1 and 11.5. According to the Table 1, the fruits in the control sample ripened entirely on the day 9 of storage, so the control stopped to check postharvest quality at day 9. Beside, the treatment of 1-MCP in combine with heat treatment for 22 hours had lower a\* value than fruits in other treatments and the control during the storage time. Hence, the chemical used in this study in combination with the durative time of heat treatment could be maintained the green color of fruit pericarp of banana cv. Kluai Khai.

The change in L\* (lightness) value of the peel of banana fruit during the storage period was investigated and the results are shown in the Table 2. It can be seen from the Table 2, the L\* value in all treatments was lower than the control during 9 days in storage. However, the control only maintained storage life for 9 days, after that the control ripened entire. After 13 days in storage, the L\* value ranged between 64.5 to 65.2 and was not significantly different between treatments ( $p=0.05$ ), and these L\* values located in the light space of chromaticity diagram (Konica Minolta). Therefore, 1-MCP used in this research in combination with the various time of heat treatment affected the maintenance of light color of banana fruit (cv. Kluai Khai).

**Changes in total soluble solids content**

The changes in total soluble solids content (TSS) of 'Kluai Khai' banana fruit fumigated with 1-MCP in combination with various time of heat treatment compared to the control are shown in the Figure 2. The TSS value of the control was significantly different to all treatments after 9 days in storage (the control was 14.67 to 24.3 and treatments were 1.67 to 4.67 % Brix). After 13 days in storage, the TSS value of fruits in all treatments ranged between 18.67 to 25.0 % Brix, and the TSS value of fruits fumigated with 1-MCP in combination with various time of heat treatment were similar to those fruits of the control on day 9 of storage, and fresh banana fruits. Thus, 1-MCP in combination with heat treatment in this study could delay significantly the ripeness of 'Kluai Khai' banana fruit.

**Table 1** Change in a\* value of the peel of banana fruit during the storage period<sup>1</sup>

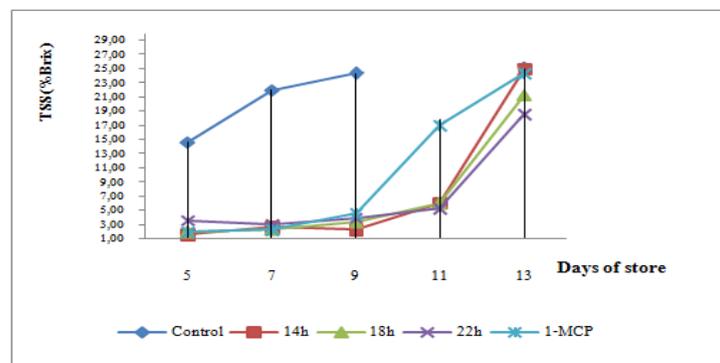
Treatments	Day 5	Day 7	Day 9	Day 11	Day 13
Control	-2,2 <sup>c</sup>	9,7 <sup>b</sup>	13,9 <sup>a</sup>	-	-
1-MCP+HT 14h	-11,1 <sup>d</sup>	-9,4 <sup>d</sup>	-5,5 <sup>c</sup>	-2,5	6,6
1-MCP+HT 18h	-11,4 <sup>d</sup>	-9,9 <sup>d</sup>	-6,4 <sup>d</sup>	-1,2	7,8
1-MCP+HT 22h	-11,4 <sup>d</sup>	-10,3 <sup>d</sup>	-7,3 <sup>d</sup>	-3,3	5,1
1-MCP	-10,9 <sup>d</sup>	-5,8 <sup>c</sup>	2,1 <sup>b</sup>	10,3	11,5

<sup>1</sup>Means within a column with the same letter are not significantly different by Duncan's multiple range test (p=0.05)

**Table 2** Change in L\* value of the peel of banana fruit during the storage period<sup>1</sup>

Treatments	Day 5	Day 7	Day 9	Day 11	Day 13
Control	65,3 <sup>a</sup>	71,6 <sup>a</sup>	65,1 <sup>b</sup>	-	-
1-MCP+HT 14h	58,0 <sup>bc</sup>	60,5 <sup>c</sup>	60,9 <sup>c</sup>	62,3	65,2
1-MCP+HT 18h	59,4 <sup>b</sup>	64,5 <sup>b</sup>	63,7 <sup>b</sup>	64,6	64,6
1-MCP+HT 22h	57,9 <sup>bc</sup>	63,5 <sup>b</sup>	62,8 <sup>bc</sup>	61,9	64,8
1-MCP	56,8 <sup>c</sup>	64,6 <sup>b</sup>	64,6 <sup>b</sup>	64,8	64,5

<sup>1</sup>Means within a column with the same letter are not significantly different by Duncan's multiple range test (p=0.05)



**Figure 2** The changes in TSS content of banana fruit cv. Kluai Khai during storage period

### Conclusion

Treatment of fumigating banana fruits in 1-MCP in combination with heat treatment for 22 hours could maintain  $a^*$  and  $L^*$  values and fruits did not show ripeness when compared to those fruits of the control and the other treatments for 13 days in storage. Furthermore, the quality of fruit expressed as total soluble solids content was not different when compared to fresh banana fruits.

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