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ผลของ Aminoethoxyvinylglycine ต่อการชะลอการสุกของผลกล้วยน้ำว้า
Effect of Aminoethoxyvinylglycine on Delaying the Ripening of 'Namwa' Banana Fruit

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Abstract

Bananas are climacteric fruits; they easily deteriorate after harvesting. The objective of this research was to investigate the effect of Aminoethoxyvinylglycine (AVG) on delayed ripening of 'Namwa' banana during storage. Banana fruits were dipped in AVG solution at concentrations of 200, 400, and 800 mg/L and tap water as control and stored at 25 ℃ for 8 days. The results showed that 400 mg/L AVG concentration reduced the respiration rate, and inhibited ethylene production. It further reduced weight loss, delayed the green color change of the peel (L^*, a^*, b^* and h^*) and maintained firmness of the banana. Therefore, the AVG concentration of 400 mg/L was the most effective in delaying the ripening of bananas during storage.

Keywords: Aminoethoxyvinylglycine, 'Namwa' banana, ripening

บทคัดย่อ

กล้วยเป็นผลไม้ประเภท climacteric ซึ่งเสื่อมสภาพได้ง่ายหลังการเก็บเกี่ยว งานวิจัยนี้มีวัตถุประสงค์เพื่อศึกษาผลของ Aminoethoxyvinylglycine (AVG) ต่อการชะลอการสุกของผลกล้วยน้ำว้าในระหว่างการเก็บรักษา ผลกล้วยถูกแช่ในสารละลาย AVG ที่ความเข้มข้น 200, 400, และ 800 มิลลิกรัม/ลิตร และน้ำประปาเป็นชุดควบคุม และเก็บไว้ที่อุณหภูมิ 25 องศาเซลเซียส นาน 8 วัน จากผลการทดลอง พบว่า AVG ที่ความเข้มข้น 400 มิลลิกรัม/ลิตร สามารถลดอัตราการหายใจ ยับยั้งการผลิตเอทิลีน อีกทั้งยังลดการสูญเสียน้ำหนัก ชะลอการเปลี่ยนแปลงสีเขียวของเปลือก (L^*, a^*, b^* และ h^*) และรักษาความแน่นเนื้อของกล้วยได้ ดังนั้นความเข้มข้นของ AVG ที่ 400 มิลลิกรัม/ลิตร จึงมีประสิทธิภาพสูงสุดในการชะลอการสุกของผลกล้วยในระหว่างการเก็บรักษา

คำสำคัญ: Aminoethoxyvinylglycine กล้วยน้ำว้า การสุก

Introduction

Banana is one of the most important fruit crops due to their nutrition and economic benefits. Banana is a climacteric fruit, they easily deteriorate after harvesting due to rapid ripening, physiological aging, texture change, and water loss (Awad *et al.*, 2017). Ethylene is a naturally produced plant growth regulator that stimulates fruit ripening and senescence of harvested fruits. High ethylene production results in subsequent fruit softening, moisture loss, increase in total soluble solids and senescence spot during ripening of 'Kluai Namwa' banana (Siriboon and Banlusilp, 2004). AVG is used as an inhibitor of ethylene biosynthesis. AVG temporarily decreases ethylene production, reduces endogenous ethylene levels and delays ripening (Saltveit,

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2005). Postharvest application of AVG reduces ethylene production and delays softening of fruits such as apple, pear, plum, and peach (Liu *et al.*, 2023). A study on extending the storage life of bananas using an ethylene inhibitor to delay fruit ripening during storage has not been previously conducted. Therefore, this study was conducted to assess the effect of AVG concentrations on postharvest quality of 'Namwa' bananas under stimulated transport condition.

Materials and Methods

Plant materials and AVG treatments preparations

'Namwa' banana was harvested from the commercial orchard with 80% maturity stage, cleaned and soaked in sodium hydrochloride at 200 ppm for 3 minutes. AVG concentrations of 200, 400 and 800 mg/L were compared with untreated fruits. All fruits were stored at 25 °C for 8 days.

Weight loss, Firmness and color Determination:

The weight loss was calculated on initial weight basis and expressed in percentage. Firmness was measured using a texture analyzer (T.A.X T Plus, Stable Micro System, England). Peel color was measured by a chroma meter CR-400 (Konica Minolta, Japan). Data recorded: L*, a*, b* and hue angle values.

Respiration rate and ethylene production

Carbon dioxide and ethylene production were measured using GC (Shimadzu 14 B, Japan).

Total Soluble Solids (TSS)

TSS was measured using a digital refractometer (Atago- Paw, Tokyo, Japan), and units were recorded in % Brix.

Total Phenolic Contents (TPC)

TPC was measured according to Singleton and Rossi (1965) method. The results were expressed as mg/100g FW.

Total Flavonoid Contents (TFC)

TFC was determined using a modified colorimetric method by Zhishen *et al.* (1999) and results expressed as mg/100g FW.

Statistical analysis:

Randomized Complete Block Design (RCBD) was used with three replicates. All data were subjected to analysis of variance (ANOVA) using SAS software version 9.0.

Results and Discussion

AVG generally delays ripening and undesirable color formation in fruit (Ozturk *et al.*, 2015). Fruit weight loss gradually increased in all treatments. At day 8, AVG at 400 mg/L recoded the lowest weight loss of 6.64% than the control fruit (9.69%) (Figure. 1A). Firmness decreased to 3.54, 3.44, 4.20 and 2.51 N in the control, 200 mg/L, 400 mg/L and 800 mg/L AVG, respectively (Figure 1). The positive effect of AVG on fruit firmness could be due to the reduction in ethylene biosynthesis and degradation of cell wall compounds and starch leading to fruit softening (Elmenofy *et al.,* 2021). Respiration rate was 156.17 mg/kg/h and 146.2 mg/kg/h in the control and 400 mg/L AVG-treated fruit (Figure 1B). The lower respiration rate by AVG is probably related to the low ethylene production (Both *et al.*, 2016). On day 8, ethylene production was 11.07 µL/kg/h in bananas treated with 400 mg/L AVG and 17.09 µL/kg/h for untreated fruits (Figures 1C and D). AVG blocks the production of 1-aminocyclopropane-1-carboxylic acid (ACC) by inhibiting its synthase, reducing the production of ethylene in the fruit (Saltveit, 2005). At AVG 400 mg/L, *L** showed the highest, while *b** values had higher value than AVG 800 mg/L treated fruit (Table 1). AVG 400mg/L preserved TSS by 18.33% than the control, followed by AVG 200mg/L with 23.33% and AVG 800mg/L with 25.67% (Table 1). Lower levels of TSS

in fruits treated with AVG may be associated with the reduction in ethylene production, resulting in less starch hydrolysis (Soethe *et al*., 2022). AVG 400mg/L presented the lowest TPC and TFC when compared to the control and other AVG treatments on day 8. The decrease in TPC may be because AVG inhibits ethylene synthesis which slows down the activity of the enzymes involved in the synthesis of phenolic and flavonoids compounds (Soethe *et al*., 2022).

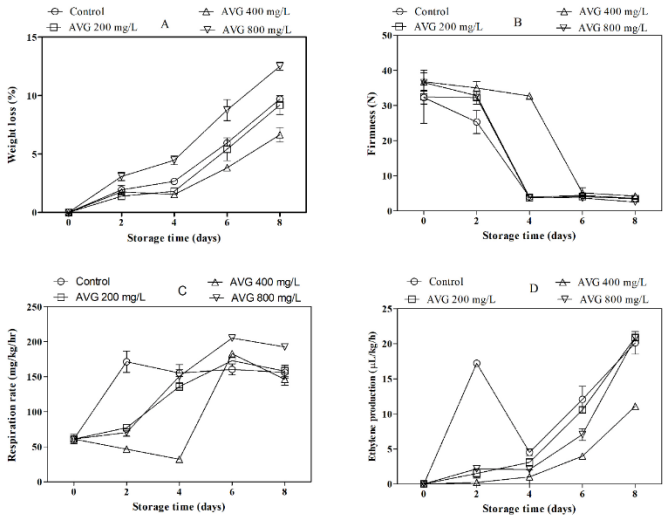

Figure 1 Effect of AVG on weight loss (A), firmness (B), respiration rate(C) and ethylene production(D) of 'Namwa' banana stored at 25 °C.

Table 1 Effect of AVG treatments on TSS, TPC, TFC and peel color of 'Namwa' banana for 8 days storage at 25 °C

Treatments	TSS (%)	TPC mg/100g	TFC mg/100g	*L**	*a**	*b**	hue
Control	26.33aA	37.65aA	21.86aA	68.44aA	5.09aA	47.04aA	82.76bE
AVG 200 mg/L	23.33aA	31.79ab	19.83aB	69.38aA	3.74aA	52.41aA	84.07bD
AVG 400 mg/L	18.33bA	30.21bA	18.21bB	70.62aA	1.98bA	49.35bA	88.20aC
AVG 800 mg/L	25.67aA	35.03aA	19.49aC	65.14aA	5.04aA	39.14aB	80.70cD

Conclusion

The postharvest application of 400 mg/L AVG delayed 'Namwa' banana fruit ripening by reducing ethylene production by 35.33% resulting in reduced respiration rate, weight loss, phenolic and flavonoids contents. In addition, it also delayed color changes, and maintained flesh firmness. Therefore, AVG at a concentration of 400 mg/L can be used as an ethylene inhibitor for 'Namwa' banana stored at 25 °C.

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References

Awad, M.A., A.D. Al-Qurashi, S.A. Mohamed, R.M. El-Shishtawy and M.A. Ali, 2017. Postharvest chitosan, gallic acid and chitosan gallate treatments effects on shelf-life quality, antioxidant compounds, free radical scavenging capacity and enzymes activities of 'Sukkari'bananas. Journal of Food Science and Technology 54: 447-457.

Both, V., F.R. Thewes, A. Brackmann, D.F. Ferreira, E.P. Pavanello and R. Wagner. 2016. Effect of low oxygen conditioning and ultralow oxygen storage on the volatile profile, ethylene production and respiration rate of 'Royal Gala'apples. Scientia Horticulturae 209: 156-164.

Liu, Z., T. Hu, C. Yu, W. Tan, Y. Shen. and L. Duan. 2023. Design of aminoethoxyvinylglycine functional analogues to delay postharvest ripening of tomato fruit. Postharvest Biology and Technology 195: 112096.

Elmenofy, H.M., S.K. Okba, A.M. Salama and S.M. Alam-Eldein, 2021. Yield, fruit quality, and storability of 'Canino'apricot in response to aminoethoxyvinylglycine, salicylic acid, and chitosan. Plants 10(9): 1838.

Ozturk, B., E. Kucuker, K. Yıldız and S.M. Celik. 2015. Changes of bioactive compounds and ethylene production of Japanese plums treated with pre-harvest aminoethoxyvinylglycine. International Journal of Food Properties 18(10): 2165-2186.

Saltveit, M.E. 2005. Aminoethoxyvinylglycine (AVG) reduces ethylene and protein biosynthesis in excised discs of mature-green tomato pericarp tissue. Postharvest Biology and Technology 35(2): 183-190.

Soethe, C., C.A. Steffens, F.J. Hawerroth, M.A. Moreira, C.V.T. do Amarante and M.C. Stanger. 2022. Quality of 'Baigent'apples as a function of pre-harvest application of aminoethoxyvinylglycine and ethephon stored in controlled atmosphere. Applied Food Research 2(1): 100117.

Siriboon, N. and P. Banlusilp. 2004. A Study on the ripening process of Namwa'banana. Faculty of Biotechnology, Assumption University Bangkok, Thailand.

Singleton, V.L. and J.A. Rossi. 1965. Colorimetry of total phenolics with phosphomolybdic-phosphotungstic acid reagents. American Journal of Enology and Viticulture 16(3): 144-158.

Zhishen, J., T. Mengcheng and W. Jianming. 1999. The determination of flavonoid contents in mulberry and their scavenging effects on superoxide radicals. Food chemistry 64(4): 555-559.