# EFFECT OF OXALIC ACID ON PEEL COLOR RETENTION AND PHYSIOLOGICAL WEIGHT LOSS IN MATOKE BANANA DURING AMBIENT STORAGE

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## ABSTRACT

High postharvest losses in Matoke banana are often attributed to rapid peel color change and excessive physiological weight loss during storage and transport. This study investigated the effect of oxalic acid on these two key parameters to determine its potential in extending the green shelf life of Matoke under ambient conditions. The experiment was conducted at the University of Ibadan in the department of Agronomy. Matoke banana fruits were treated using the dipping method with oxalic acid at concentrations of 0.1 $gL^{-1}$, 0.2 $gL^{-1}$, and 0.3 $gL^{-1}$, while control fruits were dipped in distilled water. All fruits were stored in polyethylene bags at room temperature (23.6°C–34.2°C; 26%–85% relative humidity). Peel colour and physiological weight loss were recorded at three-day intervals. Results showed that oxalic acid significantly influenced both parameters. Fruits treated with 0.1 g/L oxalic acid exhibited delayed peel colour change and the lowest weight loss throughout the storage period. As oxalic acid concentration increased, faster peel yellowing and greater weight loss were observed. The 0.1 g/L treatment maintained greener peels and reduced moisture loss, effectively prolonging the visual and physical quality of Matoke for up to 33 days. These findings suggest that oxalic acid, particularly at a concentration of 0.1 g/L, is effective in maintaining peel quality and minimizing weight loss, offering a simple and affordable method to prolong the shelf life of Matoke banana during postharvest handling.

**Keywords**: Matoke banana, oxalic acid, peel color, weight loss, post-harvest.

## INTRODUCTION

Bananas (Musa spp.) are several types of large herbaceous flowering plants in the genus Musa, a member of Musaceae producing edible fruits. Bananas came from two wild species *Musa acuminata* and *Musa balbisiana*. In some countries, cooked bananas are referred to as plantains which differentiate them from the dessert bananas. Bananas (*Musa* spp.) originated from Southeast Asia, in the region that comprises modern-day Malaysia, Indonesia, and the Philippines. Over time, they spread to Africa and Latin America through trade and colonial agricultural practices. Today, bananas are cultivated globally across 130 countries within tropical and subtropical regions worldwide (FAO, 2023). Countries like India, China, the Philippines, and Brazil are among the top producers. The widespread cultivation is due to the banana's adaptability to warm climates and its role as both a staple food and a major cash crop in many developing countries (IFAD, 2023). Fruit ripening is a complex physiological process that transforms mature fruits into palatable and nutritious products, enhancing their appeal to consumers and facilitating seed dispersal. Bananas are abundantly rich in vitamins like A-D, potassium, fiber and generally low in fat. Given that bananas are climacteric fruits that ripen naturally to pale yellow at ambient tropical temperature needs an appropriate post-harvest techniques to reduce the economic loss in the producing regions of the fruit. Appropriate post-harvest techniques must be practice to ensure high quality and safety of the banana fruit is delivered from producer to consumer. However, different preservation methodologies have been studied and recommended by the researchers. Recently, numerous fruits such as mango, potted plants and cut flowers have been reported to improve their shelf lives when treated with oxalic acid but there is insufficient information on oxalic acid in delaying the ripening of banana which prompt me to explore the relevance and application of Oxalic acid in this experiment. Oxalic acid (OA) is a naturally organic acid which plays important roles in systemic resistance , environmental response and also assuring postharvest handling techniques to maintain quality while extending storage life of fruit (Zheng et al., 2020). In addition, Oxalic acid exhibits antioxidant activities and play a serious function in systemic resistance, programmed cell death, redo homeostasis in plants and delaying senescence in harvested fruits (Zheng et al., 2022).

## METHODOLOGY

### Experimental Site

The experiment was carried out at the horticultural laboratory in the Department of Agronomy, University of Ibadan, Ibadan 7024'N, 3054'S. The minimum and maximum temperature of the room recorded was 23.60 $^0$C -34.20 $^0$C. The relative humidity recorded ranged from 26% - 85%.

### Source of Experimental Ingredients

Green mature Matoke (East African) banana fruits without any defects were purchased from a farm located at Nigeria Brewery Iwo Road, Ibadan, prior to storage period, Oxalic acid (10g) which served as the ethylene absorbent was purchased from a reputable chemical store and polythene bags for packing the fruits.

### Preparation of fruits for storage

After the fruits have been harvested and conveyed to the horticultural laboratory, banana bunches were de-handed and similar size rounded fruits were selected from each hand. All forms of impurities was removed on the fruits by washing them under tap water, then air dried at ambient temperature.

### Experimental Design

Four treatments; 0.1 $gL^{-1}$, 0.2 $gL^{-1}$, and 0.3 $gL^{-1}$ of Oxalic acid and 0$gL^{-1}$ of distilled water (untreated) with five fingers of banana for each treatment. The experiment was arranged using Completely Randomized Design (CRD) with three replicates.

### Storage Experiment

Oxalic acid in three concentrations were used in the course of this study (0.1, 0.2, 0.3g). The respective measurements of oxalic acid were obtained using a weighing scale. Dilution of each concentration of oxalic acid were diluted in 1litre of distilled water (0.1 $gL^{-1}$, 0.2 $gL^{-1}$, and 0.3 $gL^{-1}$) to give an aqueous solution for each concentration and another 1litre of distilled water served as the control. Thus, giving total of four treatments. Five (5) fingers of banana fruits represented each treatment; the five (5) fingers of banana fruits were dipped in each aqueous solution for 15minutes and dried for 30minutes before it was stored in the polythene bags under ambient

temperature and humidity. Thereafter, fruit quality assessments with respect to the following parameters were carried out 3 times interval till the end of deterioration stage.

**Experimental Observations**

Data were taken on these following physical quality parameters below at three days during storage period.

**Fruit Peel color**

Fruit peel color analysis were assessed visually by matching the peel color with standard color charts that describe the seven ripening stages, and color scores of 1-7 were assigned accordingly. The peel color chat used indicates unripe at stages1-4, and ripe at stages 5-7 (Mengistu et al., 2022).

**Fruit weight loss**

The loss in weight of the fruits were calculated by determining the differences between initial weight and final weight on the day of observation, then divided by their initial weight.

$$LW\ (\%) = \frac{\text{Initial weight (g) -final weight (g)}}{\text{Initial weight (g)}} \times 100\ \%$$

**Data Analysis**

The fourth edition of GENSTAT (2016) was used to do analysis of variance on the collected data. The least significant difference (LSD) was used to separate the means at 5% level of probability.

**RESULTS**

**Effect of Different Levels of Oxalic Acid on the color Change of Matoke Banana**

Result (fig.1) shows the results of varying concentration levels of oxalic acid on the color change on Matoke banana. There were no significant differences in color change among the levels of treatments at the days of storage. However, at 9 days after storage, the color change of the bananas in all the treatments ranged between 1 and 2 which indicated that they were all green in color with yellow tip. From 12 to 24 days after storage, bananas in 0.3 $gL^{-1}$ of oxalic acid had a sharp color change to more yellow than green color when other treatments 0 $gL^{-1}$, 0.1 $gL^{-1}$, and 0.2$gL^{-1}$ still retain the green color with yellow tip. At 27 days after storage, bananas in 0.1g/l, 0.2g/l and 0.3g/l were yellow in color whereas the control (0 $gL^{-1}$) fruits were greener than yellow. Also, at 30 days after storage, control fruits (5.67) had already attained a fully yellow color while other treatments 0.1 $gL^{-1}$, 0.2 $gL^{-1}$ and 0.3 $gL^{-1}$ were still yellow than green in color. At 33 days after storage the bananas in all the treatments were all yellow with black tips which shows a sign of deterioration.

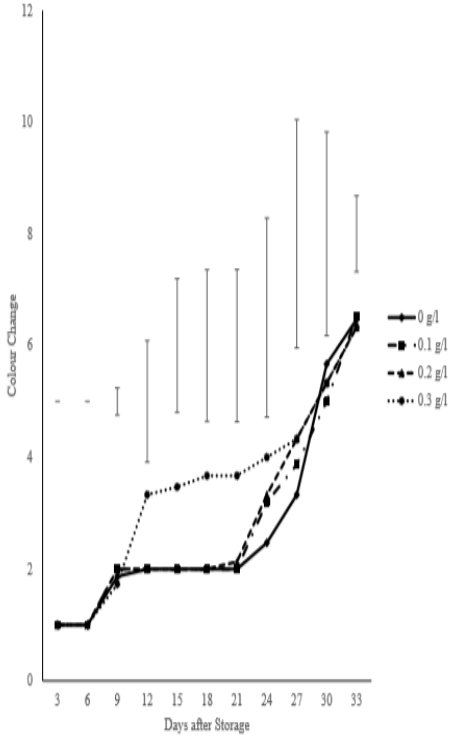


Figure 1: Effect of different levels of oxalic acid on the color change of Matoke banana

**Effect of Different Levels of Oxalic Acid on the Weight Loss of Matoke Banana**

The result obtained for weight loss were not significantly different amongst all the treatments at the days of storage as presented in fig 2. From 3 days after storage to 6 days after storage, bananas in 0.2 $gL^{-1}$ had the highest weight loss which was not significantly different from 0.1 $gL^{-1}$ which recorded the lowest. But from 12 days after storage to 33 days after storage, weight loss from 1.54% to 7.49%, whereas the bananas in 0.1 $gL^{-1}$ also had the least weight loss at the bananas in 0.3g/l consistently recorded the highest days of storage when compared with other treatments

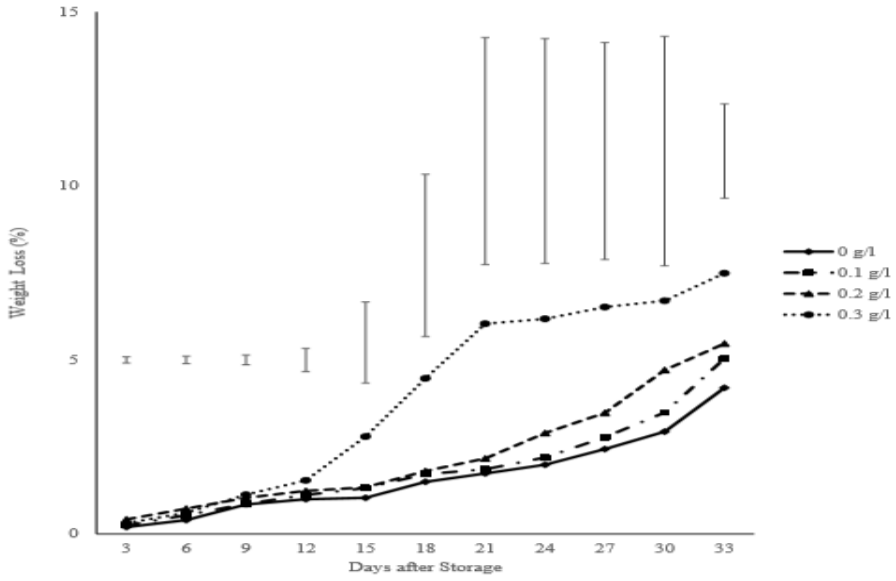


Figure 2: Effect of different level of oxalic acid on the Weight loss of Matoke banana

## DISCUSSION

In this concluded study with oxalic acid, 0.1 $gL^{-1}$ has shown to be the most effective concentration that prolonged the shelf life and maintained the physical parameter evaluated in the banana fruits in comparison to the control on the basis of color change and percentage loss in weight. The peel color gradually resulted from green to yellow appearance in all the treatments as storage progress and the chlorophyll content also decreased progressively after storage and this result aligned with the findings by Huang et al., (2023) recorded that banana fruits treated by oxalic acid displayed a slow color change and retarded to breakdown of green chlorophyll. Likewise, percentage Weight loss increases as the storage days increased in the storage of the fruits and this supports the result reported by Rathore, H., et al. (2022) that percentage weight loss increases throughout the storage period and the rate of the percentage varies depending on the fruits and storage conditions.

### CONCLUSIONS

Enhancing yield and productivity without minimizing postharvest losses will not be sufficient in securing the availability of banana fruits globally. From this research, Oxalic acid had influenced the physical parameters and also extended the shelf-life extension of matoke banana in storage. 0.1 $gL^{-1}$ of oxalic acid proved to be the most effective treatment in delaying the ripening process while the nutritional composition of the banana fruits in storage were maintained with the other levels of 0.2 $gL^{-1}$ and 0.3 $gL^{-1}$.

## REFERENCES

Food and Agriculture Organization of the United Nations (FAO). (2023). *Banana Market Review – Preliminary Results for 2023*. Retrieved from https://www.fao.org/markets-and-trade/commodities/bananas/en

Food and Agriculture Organization of the United Nations. (2023). *Banana market review – Preliminary results for 2023*. Retrieved from https://www.fao.org/markets-and-trade/commodities/bananas/en

Huang, Y., Chen, H., Wang, J., & Li, L. (2023). "Oxalic acid treatment reduces oxidative stress and maintains fruit quality in bananas during cold storage." Postharvest Biology and Technology, 195, 112-123. https://doi.org/10.1016/j.postharvbio.2023.112123

International Fund for Agricultural Development. (2016). *Banana and plantain improvement*. Retrieved from https://www.ifad.org/en/web/knowledge/ /publication/banana-and-plantain-improvement

Li, X., Zhang, Y., & Wang, B. (2022). "Effects of oxalic acid on ripening inhibition and antioxidant capacity in harvested banana fruit." Scientia Horticulturae, 304, 111-120. https://doi.org/10.1016/j.scienta.2022.111120

Mengistu, F. G., Delele, M. A., Gabbiye, N., & Fanta, S. W. (2022). "Postharvest quality changes and ripening behavior of banana (Musa spp.) as influenced by storage conditions: A review." *Heliyon*, *8*(6), e09762.

Okagu, C. (2022). Biochemical processes in fruit ripening. *Global Journal of Biochemistry and Biotechnology*, 10(2). Retrieved from https://www.globalscienceresearchjournals.org/articles/biochemical-processes-in-fruit-ripening-91232.html

Osorio, S., Costa, F., Gibon, Y., Usadel, B., & Vicente, A. (2023). Advances in fruit development and ripening. *Journal of Experimental Botany*, 74(20), 6205–6206.

Rathore, H., et al. (2022). Impact of storage duration on the quality and weight loss of sweet orange (Citrus sinensis) during ambient storage. *Journal of Food Science and Technology*, 59(1), 234-242. https://doi.org/10.1007/s11483-021-01261-7

Yang, Q., et al. (2024). Recent advances and future directions in banana molecular biology and breeding. *Molecular Horticulture*, 4(42). https://doi.org/10.1186/s43897-024-00122-2&#8203

Zhang, M., Ma, L., & Yang, X. (2020). "Postharvest oxalic acid application delays ripening and alleviates chilling injury in banana fruit." *Journal of Food Processing and Preservation*, 44(8), e14612. https://doi.org/10.1111/jfpp.14612

Zhang, Y., Wang, X., Li, H., & Zhang, H. (2022). Role of oxalic acid in plant defense and stress tolerance: A review. *Journal of Agricultural and Food Chemistry*, *70*(45), 14238–14250.