# DETERMINING THE CONCENTRATION RATES OF GIBBERELLIC ACID (GA3) AS RIPENING INHIBITOR OF LAKATAN BANANA *(Musa acuminata AAA Group)*

**BENJIE ZAMORA[1], ROWEL A. PEÑORA, L.Agr., MExEd[2], JEBUCHADNEZZAR L. SEPRADO, L.Agr., MSA, CHRA[3]**
https://orcid.org/0009-0000-2221-1456[1], https://orcid.org/0009-0007-3977-7721[2], 0009-https://orcid.org/0000-6056-6676[3]
zbenjie51@gmail.com[1], rpenora@gmail.com[2], jeybuseprado0482@gmail.com[3]
Kapalong College of Agriculture, Sciences and Technology Maniki, Kapalong, Philippines

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## ABSTRACT

Lakatan (Musa acuminata AAA Group) is one of the most essential banana variety commodities in the Philippines as a tropical country. This present study was conducted to determine and investigate the effects of (GA3) Gibberellic Acid in different concentration rates as post-harvest treatments on the shelf life and quality of bananas like physiological weight, peel color, and its pulp-to-peel ratio to determine which of treatments can prolong the shelf life of the banana; and to evaluate the most effective rates of GA3 that have the highest efficacy against the rapid ripening activity of 'Lakatan' banana variety as well as banana sample are soaked into the different concentration of treatment with the duration of five minutes then air dried for ten minutes and put into a polyethylene plastic cellophane which was open with cardboard boxes in each replication and placed under room temperature. This study was arranged in a Completely Randomized Design (CRD) with five treatments and replicated three times. The treatments were: where T1 - is a control which contains 1000 ml pure distilled water, T2 -consists of 100 ml GA3 mixed with 900 ml water, T3 -comprised of 200 ml GA3 mixed with 800 ml water, T4 - consists of 300 ml GA3 mixed with 700 ml water and T5 - contained 400 ml GA3 mixed with 600 ml water. This design was utilized to show the results intended for this study. Results of the study revealed highly significant differences among using different concentration rates of plant growth hormones GA3 as post-harvest treatments like cumulative physiological loss in weight, shelf life, peel color index, pulp peel ratio, No. Of days that the samples start to ripen, no. of ripe fingers, no. of unripe fingers, no. of days that all the models are fully unripe, and no of days that the pieces are fully ripened.

*Keywords: plant growth hormones, ripening, Lakatan, Musa, postharvest, distilled water, gibberellic acid*

## INTRODUCTION

The inhibition of banana ripening is a critical aspect of the banana industry, impacting both producers and consumers. This thesis will investigate the various methods and technologies employed to delay the ripening process, exploring their effectiveness, environmental implications, and the potential to reduce food waste. By examining the science behind banana ripening and the practical applications of inhibiting it, we aim to contribute to the sustainable management of this globally cherished fruit.

The study's primary objective is to prevent and reduce the problem of postharvest losses of Lakatan bananas (Musa acuminata AAA Group) by using GA3 as postharvest treatments to postpone the ethylene-induced quick ripening processes. Lakatan is one of the principal crops cultivated in tropics and subtropics areas of the world, it is a crop that is widely farmed. This fruit crop has been grown since the dawn of civilization and is one of the oldest. Currently, 130 countries throughout the world grow bananas in tropical and subtropical climates. Southeast Asian countries are the largest consumers of bananas (Mohandas & Ravishankar, 2016).

Lakatan banana was ranked as the fourth most important food crop after wheat, corn, and rice (Hailu et al., 2013). Over 5.6 million hectares of plantations were used to produce the approximately 114 million metric tons of bananas that were made globally each year (Maduwanthi & Marapana, 2019). The global banana production was estimated at around 192 million tons in 2017. Banana exports were projected to have had a global worth of US$8 billion in 2016 and a retail value of between $20 and $25 billion. The dessert banana, particularly the "Cavendish" type, has a significant economic impact on many developing nations. Top producers and consumers alike, such as Brazil, the Philippines, and especially India and China, have accounted for the majority of the growth in global production which is why the way of different postharvest treatments must address postharvest losses (FAO, 2019).

Given its output and monetary importance, the banana is regarded as the most significant crop in the Philippines. The cultivation of bananas, one of the nation's most economically substantial crops, takes the top spot since it boosts the national economy by more than $100 million USD annually. Davao is regarded as the Philippines' top region for commercial banana production. Among the cultivated banana types, Cavendish, Lakatan, and Saba account for 48, 30, and 11% of the overall production (Philippine Statistics Authority, 2012).

Moreover, Lakatan bananas are grown and harvested all year, and the Philippines produced up to 910 metric tons in 2017. While some of this produce is dispersed, matured, and sold in the local markets, other portions are shipped to other nations in air-conditioned containers (Department of Agriculture–High-Valued Crops Development Program [DA-HVCDP], 2019). It is the kind of banana that Filipinos like to eat. The Philippines' banana sector is in excellent shape as well. Estimated banana production for the months of July through September 2020 was 2.36 million. tons in metric. It decreased by -1.3% from its same-period 2019 level of 2.39 million tons in metric. More than half (50.6%) of the total were of the Cavendish cultivar. Banana harvesting variants of Saba and Lakatan came next with corresponding shares that make up 28.4% and 11.11% of the total. The Davao Region recorded the largest production at 872.74 thousand metric tons. It made up 36.9% of the overall production. Then came the following: Northern Mindanao and SOCCSKSARGEN scored 22.5 and 12.2 percent respectively shares (Philippine Statistics Authority [PSA], 2018).

The study must be conducted urgently since it is a phenomenon that needs to be addressed since banana exports must be free from post-harvest losses which is the main problem of the farmers and traders caused by ethylene's quick release. This might lead to rapid repining processes that prevent the fruit from reaching its destination or the intended consumer. During the late ripening stage, bananas quickly change in texture, followed by excessive tissue softening and final spoilage. Each year's crop suffers severe damage, with post-harvest losses varying from 25 to 50%. To delay fruit ripening and softening, use growth regulators that block endogenous or

exogenous ethylene, such as gibberellic acid, kinetin, potassium permanganate, and 1-Methylcyclopropene (1-MCP) (Sahithya et al., 2017). The use of plant growth regulators improves output by correcting a variety of physiological problems to raise fruit quality and production. Gibberellic Acid (GA3) and other plant growth regulators were essential for extending banana shelf life (Sultana et al., 2012).

The current experiment was carried out to ascertain the suitable different concentration rates of (GA3) Gibberellic Acid as postharvest treatments for prolonging the shelf life of bananas and their effects on quality attributes with the aim of producing new knowledge. So that the institution and area will be better able to support current and future farmers in all areas of agriculture. The community will benefit more from it, since it will provide an excellent opportunity for them to learn about the usage of (GA3) Gibberellic Acid to minimize the postharvest losses due to the rapid ripening activity of the Lakatan banana production industry specially those farms that is far away from the market and for exports also that travels in days. Additionally, this will assist in formulating or developing new initiatives and programs that can aid in the community's and students' professional growth in the agricultural industry in the country.

## OBJECTIVES OF THE STUDY

The study explores to find out suitable methods for prolonging the shelf life of bananas with the use of diverse concentration rates of GA3 as postharvest treatments. Specifically, it aims to accomplish the following objectives:

1. to investigate the effects of (GA3) Gibberellic Acid in different concentration rates as post-harvest treatments on the shelf life and quality of bananas like physiological weight, peel color, and its pulp to peel ratio;
2. to reduce Food Waste by delaying ripening, fewer bananas are discarded due to over-ripeness, contributing to the reduction of food waste;
3. to extend Market Reach, inhibiting ripening allows for the transportation of bananas to distant markets, expanding the reach of banana producers and increasing economic opportunities;
4. to improve Quality Control that enables better quality control, ensuring that bananas reach consumers in optimal condition, thus enhancing consumer satisfaction and trust;
5. to determine which of the treatments can prolong the shelf life of the banana and
6. to evaluate the most effective rates of GA3 that have the highest efficacy against the rapid ripening activity of ‘Lakatan’ banana variety.

## METHODOLOGY

A quantitative experimental research design was used to systematically explore whether there is a cause-and-effect relationship between variables. The design was an experiment on Determining the Concentration Rates of (GA3) Gibberellic Acid as a Ripening Inhibitor of Lakatan Banana. Collecting and evaluating numerical data is the process of quantitative research. As Bhandari (2022), it can be used to identify patterns and averages, make predictions, check the validity of causal links, and extrapolate findings to larger groups. According to Creswell (2014), a technique for evaluating objective theories by examining the relationship between variables is an addition to quantitative research. Five treatments were laid out in the study, using a Completely Randomized Design (CRD) with three replications; five finger test fruits were selected for each treatment replication. Thus, there were 75 fingers of banana test fruits in total, where samples are numbered individually to have a sign for observations like cumulative physiological loss in weight, shelf life, peel color index, pulp peel ratio, No. Of days that the samples start to ripen, no. of ripe fingers, no. of unripe fingers, no. of days that all the samples are fully unripe, and no of days that the samples are

fully ripened. Which assigns treatments entirely at random was a component of this experimental methodology. It has five treatments and three replications, where T1 is the control, which contains 1000 ml pure Distilled water, T2 consists of 100 ml GA3 mixed with 900 ml water, T3 consists of 200 ml GA3 mixed with 800 ml water, T4 consists of 300 ml GA3 mixed with 700 ml water, and T5 consist of 400 ml GA3 mixed with 600 ml water.

This study was conducted at Purok 12A-Calian, Maniki Kapalong Davao Del Norte on the island of Mindanao, and the sample Lakatan Banana was collected at Purok 1 Hinagtungan, Aguinaldo, Laak Davao de Oro where the Lakatan production is a trend and widely source of their living. It was brought in Calian in Kapalong, where my current residence is. Moreover, the study has an estimated one-and-a-half-month duration, from February to March. The time duration was significant to determine the effectiveness of GA3 as a postharvest treatment in Lakatan for delaying its ripening processes.

In conducting this study, the data gathered by the researcher are presented below as follows:

*No. of Days that the Samples Remain Unripe.* This was done by counting the days after storage and application of treatments so that samples in each treatment remained unripe.

*No. of Days that the Samples Start to Ripen.* This was done by counting the Days After storage (DAS) that the samples in each treatment showed a sign of ripening activity during storage after the application of GA3.

*No. of Days that the Samples are Fully Ripen.* This was done by counting the days after storage that the samples were all fully ripened to identify which treatment/s was significant.

*No. of Ripe Fingers*. This was done by counting the number of fingers in each treatment that has already the sign of ripening and already ripened on 12$^{th}$ and 15$^{th}$ day after storage.

*No. of Unripe Fingers***.** This was done by identifying and counting the unripe fingers, which fully remain green on the 12$^{th}$ and 15$^{th}$ day after storage and application of treatments.

**Data Analysis**

*Physiological Loss in Weight (PLW%).* This was done by the digital electronic weighing scale balance used to determine fruit weight in 3-day intervals up to 21 days. The cumulative weight loss calculated according to the formula adopted by Tourky et al. (2014) (Eq. 1)

$$W1\frac{W0-Wt}{W0}x100\%$$

Where W1 is the percentage weight loss, W0 is the initial weight of fruits, and Wt is the weight of the fruits at the designated time.

*Pulp Peel Ratio*. "When the experiment reached its midpoint of 50% decomposition, a sharp knife was employed to distinguish the peel from the pulp. Each component was weighed using a digital scale and quantified as the peel-to-pulp ratio. This ratio was calculated using Equation 2, as prescribed by Tourky et al. (2014)."

$$Pulp\ to\ Peel\ Ratio = \frac{Pulp\ Weight}{Peel\ weight}$$

*Shelf Life.* The fruits' shelf life was calculated by counting the number of days from the start of the experiment until 50% of the test fruits in each replication had rotted.

*Color Rating Scale.* A conventional banana ripening scale was used to measure the change in peel color from 7 days after storage up to 21 days afterwards. The scale has a range of 1 to 7. As follows 1 -when green,2- light green, 3-light green with yellow, 4-yellow with some green,5- yellow with green tips, 6-totally yellow, and then 7-when

yellow with brown patches are present. (Acero, 2015).

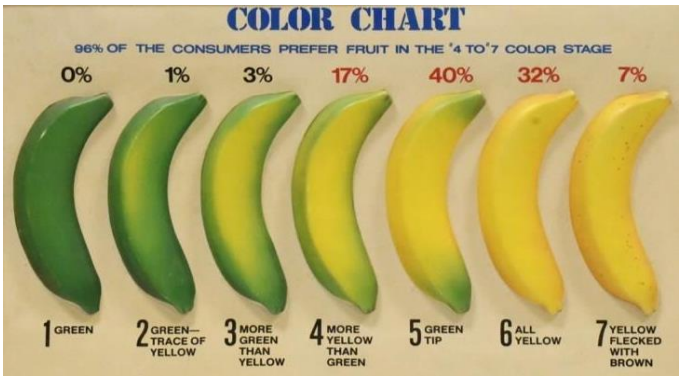


*Figure 2. Color Rating Scale*

*Statistical analysis.* MS-Excel 2010 was used to assemble and enter the information. The GenStat 15th edition procedures were used to carry out the analysis of variance for all parameters. At a 5% level of significance, the Duncan's Multiple Range Test (DMRT) was run to determine mean separations (Gomez & Gomez, 1984). Tables and graphs were made using the MS-Excel 2010 program.

*Experimental Design and Treatments.* "The experiment employed a Completely Randomized Design (CRD) with five treatments, each replicated three times. To prepare the 100% total gibberellic acid (GA3) solution, 2.5 grams of GA3 were dissolved in 1000 mL of distilled water using two and a half (0.5 g each sachet) packs of the stock solution containing 40% gibberellic acid. The test fruits in each treatment were individually soaked for 30 minutes in solutions with different concentrations, as described below:

**$T_1$** -Control- 1000 mL Distilled Water
**$T_2$** -100mL GA3+900mL Distilled Water
**$T_3$** - 200mL GA3+ 800mL Distilled Water
**$T_4$** - 300mL GA3+ 700mL Distilled Water
**$T_5$** -400mL GA3+ 600mL Distilled Water

## RESULTS AND DISCUSSION

### 1. No. of Days that the Samples Remain Unripe

**Table 1**

*Number of Days that the Samples Remain Unripe of Lakatan Treated with different concentration rates of GA3 as ripening inhibitor under ambient room temperature 24.1 $C^0$ – 30.6 $C^0$ with a relative humidity range from 79% to 99%.*

| Treatment | Replication | | | Mean** |
|---|---|---|---|---|
| | I | II | III | |
| T1- PURE WATER | 10 | 10.2 | 10.6 | 10.27 $^{c}$ |
| T2-100 ML (GA3) + 900 ML WATER | 11.4 | 13 | 12.4 | 12.27 $^{b}$ |
| T3-200 ML (GA3) + 800 ML WATER | 14.4 | 14 | 14.6 | 13.33 $^{a}$ |
| T4-300 ML (GA3) + 700 ML WATER | 15.2 | 15 | 14.6 | 14.93 $^{a}$ |
| T5-400 ML (GA3) + 600 ML WATER | 16.4 | 15.2 | 14.2 | 15.27 $^{a}$ |

*CV=4.88% **-Highly significant*

In Duncan's Multiple Range Test (DMRT), means that share the same letter as a superscript are considered not significantly different at a 5% significance level.

Table 1 presented the data on the number of days that the samples remain unripe treated with different concentration of GA3 as ripening inhibitor. Observation shows that Treatment 3 is enough to inhibit the quick release of ethylene of Lakatan fruits which lead to quick ripening as well as with the increasing rate of GA3 which was the treatment 4 and 5 is more effective. Treatment 5 attained the highest mean of 15.27, next is the Treatment 4 with the mean of 14.93, followed by Treatment 3 with the mean of 13.33, then Treatment 2 with the mean of 12.27, and the control which is the Treatment 1 attain the lowest mean and has the lesser number of days to remain unripe.

The data revealed that on the number of days that the test fruits start to ripen as applied with different concentration rates of GA3 as ripening inhibitor. However, Treatment 5 got the highest mean on the number of days the that the sample test fruits start to ripen with the mean of 15. 30 followed by Treatment 4 and 3 with a mean of 14.80

and 14.53 which is enough to delay the ripening days of Lakatan based on the results. In Treatment 2 with a mean of 12.20 and the shortest number of days that the samples start to ripen is being achieved in the control with the mean of 10.47 and the earliest samples showed a ripening sign that is comparable among other treatments.

## 2. No. of Days that the Samples Start to Ripen

**Table 2**

*Number of Days that the Samples Start to Ripen of Lakatan Treated with different concentration rates of GA3 as ripening inhibitor under ambient room temperature 24.1 $C^0$ – 30.6 $C^0$ with a relative humidity range from 79% to 99%.*

| Treatment | Replication | | | Mean** |
|---|---|---|---|---|
| | I | II | III | |
| T1 - PURE WATER | 10.2 | 10.4 | 10.8 | 10.47 [b] |
| T2 - 100 ML (GA3) + 900 ML WATER | 11.4 | 12.8 | 12.4 | 12.20 [b] |
| T3 - 200 ML (GA3) + 800 ML WATER | 14.4 | 14.4 | 14.8 | 14.53 [a] |
| T4 - 300 ML (GA3) + 700 ML WATER | 14.8 | 14.8 | 14.6 | 14.80 [a] |
| T5 - 400 ML (GA3) + 600 ML WATER | 16.4 | 15.4 | 14 | 15.30 [a] |

*CV=4.86% **-Highly significant*

Duncan's Multiple Range Test (DMRT) means that sharing the same letter as a superscript is considered not significantly different at a 5% significance level.

The increasing concentration levels of GA3 can delay the start of the ripening days of Lakatan Banana since GA3 acts as mobile molecules that can pass through the plasma membrane for cell-to-cell transport.

## 3. No. of Days that the Samples are Fully Ripened

The data on the days that the samples were fully ripened and treated with different concentration rates of GA3 as a ripening inhibitor were presented in Table 3. A highly significant result is shown in the ANOVA (Appendix Table A). It was observed that among the treatments, control or Treatment 1 has the lowest mean attained with the mean of 12.73 in the number of days fully ripened since it was untreated with GA3 and shows a short time period to fully ripen compared to the treated fruits. Then, Treatment 2 with a mean of 16.40.

**Table 3**

*Number of Days that the Samples are Fully Ripened of Lakatan Treated with different concentration rates of GA3 as ripening inhibitor under ambient room temperature 24.1 $C^0$ – 30.6 $C^0$ with a relative humidity range from 79% to 99%*

| Treatment | Replication | | | Mean** |
|---|---|---|---|---|
| | I | II | III | |
| T1- PURE WATER | 12 | 13 | 13.2 | 12.73 [c] |
| T2 - 100 ML (GA3) + 900 ML WATER | 16 | 16.2 | 17 | 16.40 [b] |
| T3 - 200 ML (GA3) + 800 ML WATER | 18.4 | 19 | 19 | 18.80 [a] |
| T4 - 300 ML (GA3) + 700 ML WATER | 18.6 | 19.2 | 18.4 | 18.73 [a] |
| T5 - 400 ML (GA3) + 600 ML WATER | 20.2 | 19.6 | 18.2 | 19.33 [a] |

*CV=3.71% ** Highly significant*

In Duncan's Multiple Range Test (DMRT), means that sharing the same letter as a superscript is considered not significantly different at a 5% significance level.

Treatment 5 attained the highest mean of 19.33, followed by Treatment 4 with a mean of 18.73, and following that is Treatment 3 with a mean of 18.80. Treatment 3 is good enough concentration to slow down the ripening processes of Lakatan Banana to aid the postharvest losses due to the quick release of ethylene.

## 4. Shelf Life

Another data on shelf life as affected by different concentration rates of GA3 as a ripening inhibitor of Lakatan banana is reflected in Table 4. As a researcher, it is crucial to extend the shelf life of bananas. In fact different postharvest treatments in this experiment produced noticeably varied results. This is a list of the many GA3 applications and the shelf life of bananas.

**Table 4**

*Shelf life of Lakatan Treated with different concentration rates of GA3 as ripening inhibitor under ambient room temperature 24.1 $C^0$ – 30.6 $C^0$ with a relative humidity range from 79% to 99%*

| Treatment | Replication | | | Mean** |
|---|---|---|---|---|
| | I | II | III | |
| T1 - PURE WATER | 20.4 | 20.4 | 20.4 | 20.40 $^{c}$ |
| T2 - 100 ML (GA3) + 900 ML WATER | 24.6 | 24.6 | 23.2 | 24.14 $^{b}$ |
| T3 - 200 ML (GA3) + 800 ML WATER | 26.8 | 26.8 | 26.8 | 26.80 $^{ab}$ |
| T4 - 300 ML (GA3) + 700 ML WATER | 27.8 | 28.2 | 26.2 | 27.40 $^{a}$ |
| T5 - 400 ML (GA3) + 600 ML WATER | 31.4 | 29.4 | 26.8 | 29.20 $^{a}$ |

*CV=4.66% **-Highly significant*

In Duncan's Multiple Range Test (DMRT), means that sharing the same letter as a superscript is considered not significantly different at a 5% significance level.

In comparison to the control, bananas in treatments 2, 3, and 4 had statistically highly significant results. The untreated GA3 fruits of the banana had the shortest shelf life (20.40 days) and reached its 50 percent rotting. With the application of treatment 5, the shelf life was measured at a maximum of 29.20 days and a minimum of 20.40 days in untreated fruit, indicating a successful outcome in extending the shelf life.

## 5. Pulp Peel Ratio

**Table 5**

*Pulp Peel Ratio of Lakatan Treated with different concentration rates of GA3 as ripening inhibitor under ambient room temperature 24.1 $C^0$ – 30.6 $C^0$ with a relative humidity range from 79% to 99%.*

| Treatment | Replication | | | Mean** |
|---|---|---|---|---|
| | I | II | III | |
| T1 - PURE WATER | 2.472 | 2.766 | 2.772 | 2.67 $^{b}$ |
| T2 - 100 ML (GA3) + 900 ML WATER | 2.91 | 2.772 | 2.97 | 2.88 $^{b}$ |
| T3 - 200 ML (GA3) + 800 ML WATER | 3.268 | 3.324 | 3.256 | 3.28 $^{a}$ |
| T4 - 300 ML (GA3) + 700 ML WATER | 3.602 | 3.612 | 3.23 | 3.48 $^{a}$ |
| T5 - 400 ML (GA3) + 600 ML WATER | 3.622 | 3.708 | 3.446 | 3.59 $^{a}$ |

*CV=4.56% **-Highly significant*

In Duncan's Multiple Range Test (DMRT), means that sharing the same letter as a superscript is considered not significantly different at a 5% significance level.

The Table 5 presented the data on the Pulp Peel Ratio of Lakatan applied with GA3 at varying rates. The analysis of variance (Appendix A) showed a Highly Significant result. Observation demonstrates that postharvest treated fruits' pulp-to-peel ratio together with their mean values. The results showed that the control (untreated fruits) and Treatment 2 had the lowest pulp-peel ratio during the storage period, with a mean of 2.67 and 2.88, respectively. On the other hand, other treatments had the highest means in terms of pulp-peel ratio. Compared to treatments 3, 4, and 5 and treatment 1, which was the control, they all produced significant improvements in pulp peel ratio, which is consistent with the findings of Tourky et al. (2014), which states that the more concentrated the GA3 as is the more effective in prolonging the pulp peel ratio quality of the bananas.

In terms of the Color Rating of Lakatan Treated with GA3 at varying rates, Subsequently, as per observation of the color change on the 7th day of gathering the data, it was shown that Treatment 1 attained the highest mean since it was the untreated test fruits that can undergo faster ripening that leads to quick peel color change continuously in the 14th day together with a lower concentration of GA3 which is the Treatment 2. Where fruits reached full yellow color (stage 7) on the 21st day.

## 6. Color Rating Scale

On the 14th day of observation, the color change of Treatment 3, 4, and 5 were at stage 2 which observed a highly delayed in color change. The fruits in the control (untreated fruits) and

Treatment 2 with the lower concentration of GA3, were discarded on day 21st when they were fully ripe and displayed a yellow tint with an expanding brown spot. The results of the analysis of variance (ANOVA) showed a highly significant result among the treatments.

**Table 6**

*Color Rating Scale of Lakatan Treated with different concentration rates of GA3 as ripening inhibitor under ambient room temperature 24.1 $C^0$ – 30.6 $C^0$ with a relative humidity range from 79% to 99%.*

| Treatment | Color Rating Means | | |
|---|---|---|---|
| | 7 DAS ** | 14 DAS** | 21 DAS** |
| T1 - PURE WATER | 1.53 a | 4.80 a | 7.00 a |
| T2 - 100 ML (GA3) + 900 ML WATER | 1.00 b | 4.73 a | 7.00 a |
| T3 - 200 ML (GA3) + 800 ML WATER | 1.00 b | 2.60 b | 5.33 b |
| T4 - 300 ML (GA3) + 700 ML WATER | 1.00 b | 2.13 b | 5.47 b |
| T5 - 400 ML (GA3) + 600 ML WATER | 1.00 b | 2.27 b | 5.33 b |
| Grand Mean | 1.11 | 3.31 | 6.03 |
| CV (5%) | 9.33 | 20.6 | 4.45 |

**- highly significant; Means in the same column followed by identical lowercase letters are not considered significantly different as per the Duncan Multiple Range Test at a 5% significance level.

"The Physiological Loss in Weight (PLW%) data for Lakatan bananas subjected to various concentrations of GA3 as a ripening inhibitor indicated a highly significant difference between the 6th and 18th days, while no significant difference was observed on the 3rd and 21st days. Although no significant differences were observed on the remaining days, the results displayed a noteworthy variation on the 6th and 18th days of treatment. These findings revealed that the rate of physiological weight loss gradually increased with prolonged shelf life, reaching its peak in the control group and the bananas treated with the highest concentration of GA3. At the same time, it was minimized in bananas treated with 200 ml of gibberellic acid mixed with 800 ml of distilled water."

## 7. Physiological Loss in Weight (PLW%)

**Table 7**

*Physiological Loss in Weight (PLW%) of Lakatan Treated with different concentration rates of GA3 as ripening inhibitor under ambient room temperature 24.1 $C^0$ – 30.6 $C^0$ with a relative humidity range from 79% to 99%*

| Treatment | Physiological Loss In Weight (Plw%) Means | | | | | | |
|---|---|---|---|---|---|---|---|
| | 3DAS$^{NS}$ | 6DAS** | 9DAS** | 12DAS** | 15DAS** | 18DAS** | 21DAS$^{NS}$ |
| T1 - PURE WATER | 1.39 | 2.68$^{bc}$ | 4.28$^{ab}$ | 6.50$^{ab}$ | 8.12$^{ab}$ | 10.28$^{ab}$ | 13.03 |
| T2 - 100 ML (GA3) + 900 ML WATER | 1.43 | 2.65$^{bc}$ | 4.18$^{ab}$ | 6.61$^{ab}$ | 8.92$^{a}$ | 11.01$^{a}$ | 12.49 |
| T3 - 200 ML (GA3) + 800 ML WATER | 1.03 | 2.57$^{c}$ | 3.56$^{b}$ | 5.06$^{b}$ | 6.88$^{b}$ | 9.03$^{b}$ | 11.77 |
| T4 - 300 ML (GA3) + 700 ML WATER | 1.17 | 3.30$^{ab}$ | 4.25$^{ab}$ | 5.64$^{ab}$ | 7.55$^{ab}$ | 9.43$^{ab}$ | 11.73 |
| T5 - 400 ML (GA3) + 600 ML WATER | 1.91 | 3.68$^{a}$ | 4.94$^{a}$ | 6.73$^{a}$ | 8.48$^{ab}$ | 11.04$^{a}$ | 13.30 |
| Grand Mean | 1.39 | 2.98 | 4.24 | 6.11 | 7.99 | 10.16 | 12.47 |
| CV (5%) | 24.12 | 12.17 | 10.61 | 9.43 | 7.78 | 7.15 | 11.03 |

**- Highly Significant; NS-Not Significant Means in the same column followed by identical lowercase letters are not considered significantly different as per the Duncan Multiple Range Test at a 5% significance level.

The data revealed varying results in terms of the number of Unripe Fingers of Lakatan Treated with different concentration rates of GA3. As mentioned earlier, Gibberellic Acid can delay the ripening of Lakatan Bananas since it can inhibit or suppress the quick release of ethylene. It was observed that Treatment 5 attained the highest mean of 5.00 on the 12th DAS has the same result as Treatment 4, and Treatment 3 is enough to delay/inhibit the ripening and suppress the ethylene release of Lakatan Bananas compared to Control and Treatment 2 which has the lower concentration of GA3. On the 15th DAS, the results showed that Treatment 5 and 4 got the highest mean of 4.00, then Treatment 3, with a mean of 3.00, is effective enough against quick ripening processes compared to control and Treatment 2, which attained the lowest mean of 1.00. The (ANOVA) Analysis of Variance showed highly significant differences in results among treatments.

## 8. No. of Unripe Fingers

**Table 8**

*Number of Unripe Fingers of Lakatan Treated with different concentration rates of GA3 as ripening inhibitor under ambient room temperature 24.1 $C^0$ – 30.6 $C^0$ with a relative humidity range from 79% to 99%*

| Treatment | Number of Unripe Fingers means | |
|---|---|---|
| | 12 DAS ** | 15 DAS** |
| T1 - PURE WATER | 1.00 c | 1.00 b |
| T2 - 100 ML (GA3) + 900 ML WATER | 3.33 b | 1.00 b |
| T3 - 200 ML (GA3) + 800 ML WATER | 5.00 a | 3.00 a |
| T4 - 300 ML (GA3) + 700 ML WATER | 5.00 a | 4.33 a |
| T5 - 400 ML (GA3) + 600 ML WATER | 5.00 a | 4.00 a |
| Grand Mean | 3.87 | 2.67 |
| CV (5%) | 13.36 | 25.62 |

**- Highly Significant; Means in the same column followed by identical lowercase letters are not considered significantly different as per the Duncan Multiple Range Test at a 5% significance level.

The number of Ripe Fingers of Lakatan Treated with different concentration rates of GA3 implies that the number of ripe fingers in control got the highest mean of 5.00 on the 12th and 15th days, followed by Treatment 2 with a mean of 1.33 in the 12th days and 4.67 on 15th days. It is comparable to the test fruits treated with higher concentration of GA3 shows the lowest mean which means the ripening processes of Lakatan treated with higher concentration rates of GA3 can delay the process of ripening as the ethylene release. The (ANOVA) Analysis of Variance showed a highly significant difference in results among treatments.

## 9. No. of Ripe Fingers

**- Highly Significant; Means in the same column followed by identical lowercase letters are not considered significantly different as per the Duncan Multiple Range Test at a 5% significance level.

**Table 9**

*The number of Ripe Fingers of Lakatan Treated with different concentration rates of GA3 as ripening inhibitor under ambient room temperature 24.1 $C^0$ – 30.6 $C^0$ with a relative humidity range from 79% to 99%*

| Treatment | Number Of Ripe Fingers Means | |
|---|---|---|
| | 12 DAS ** | 15 DAS** |
| T1 - PURE WATER | 5.00a | 5.00a |
| T2 - 100 ML (GA3) + 900 ML WATER | 1.33b | 4.67a |
| T3 - 200 ML (GA3) + 800 ML WATER | 1.00b | 2.00b |
| T4 - 300 ML (GA3) + 700 ML WATER | 1.00b | 2.00b |
| T5 - 400 ML (GA3) + 600 ML WATER | 1.00b | 2.00b |
| Grand Mean | 1.87 | 3.13 |
| CV (5%) | 13.83 | 21.80 |

## CONCLUSIONS

The data collected underwent statistical analysis through Analysis of Variance (ANOVA) using the F-test, and mean comparisons were conducted following the procedures of Duncan's Multiple Range Test (DMRT) at a significance level of 5%.

The study's results and findings demonstrated highly significant effects on various parameters, including the number of days required for the fruit to remain unripe, the duration for the sample to ripen and fully ripen, its shelf life, and the quality of the banana. This quality assessment encompassed physiological weight, peel color, and the pulp-to-peel ratio. These effects were observed due to applying different concentrations of GA3 as postharvest treatments for Lakatan Bananas compared to untreated control fruits.

Consequently, the ripening process was significantly delayed in the control group as the level of gibberellic acid increased. Using gibberellic acid offered growers a means to effectively manage the ripening of banana fruit based on the tested concentrations.

## RECOMMENDATIONS

The researcher recommends to use of GA3 as postharvest Treatment of Lakatan Banana,

specifically with a concentration of 200 ML of GA3 mixed with 800 ML water and soaking for 15 minutes since it exceeds all the parameters taken and prolongs the overall quality attributes as well as delayed ripening days of Lakatan compared to control (1000 ml Distilled Water) and Treatment 2 (100 ml GA3+900 ml Distilled Water) that has a lower concentration.

The author also suggested that further studies should be conducted on the uses of GA3 as postharvest treatments in different concentrations to determine, evaluate, and justify further results on the effectiveness to aid the postharvest losses in the country as it may also have a significant effect to the quality. This discovery will benefit banana farmers' businesses by extending the shelf life while maintaining the quality and reducing financial loss.

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## AUTHORS' PROFILE

**Benjie A. Zamora** completed his Bachelor of Agricultural Technology degree at Kapalong College of Agriculture, Sciences, and Technology (KCAST) last June 23, 2023. In 2022, he has been a valued officer of Future Farmers of the Collegiate Chapter (FFPCC). He has actively broadened his expertise by participating in and completing various workshops and seminars hosted by reputable organizations such as ICEPD Thailand and

Southern Mindanao Agriculture, Aquatic, and Natural Resources Research and Development Consortium (SMAARRDEC) held at USEP Obrero Davao Campus and others in the realm of agriculture, research, and training.

**Rowel A. Peñora, L.Agr., MExEd**, completed his Bachelor of Agricultural Technology degree at Kapalong College of Agriculture, Sciences, and Technology (KCAST) in April 2019. He earned his master's degree from the University of Southeastern Philippines in Tagum during the academic year 2022-2023.

Since 2021, he has been a valued faculty member at KCAST. He has actively broadened his expertise by participating in and successfully completing various workshops and seminars hosted by reputable organizations such as CHED, BPI, DA, ATI, and others in the realm of agriculture, research, and training.

**Jebuchadnezzar L. Seprado, L.Agr., MSA, CHRA,** finished his undergraduate degree of Bachelor of Agricultural Technology major in Crop Protection as well as his graduate degree, Master of Science in Agriculture major in Crop Protection, in the University of Southeastern Philippines – Apokon, Tagum City. He is also currently accomplishing is dissertation for his doctoral degree, Doctor of Philosophy in Agriculture major in Horticulture from the same state university. He has also held multiple eligibilities being a Licensed Professional Agriculturist and a Certified Human Resource Associate (CHRA).

Presently, he is the Program Head of the Agriculture Department of the Kapalong College of Agriculture, Sciences and Technology. He is also an active scholar who is affiliated with esteemed associations and organizations such as the Philippine Agriculturist Association and Fertilizer and Pesticide Authority. His leanings are mainly on agricultural education, agricultural trends, and research.

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