SHELF-LIFE ENHANCEMENT OF *Carica papaya* USING ZINC OXIDE AS NANOPARTICLES

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CHAPTER I

THE PROBLEM AND ITS SCOPE

Background of the Study

Food waste is a significant problem for our economy right now. In spite of the various nutritional advantages, eating fruits and vegetables improperly can be quite dangerous. Due to the presence of poisonous bacteria, fungus, and poisons, it has a number of undesirable effects. Gardens often produce too much food at one time, more than can be eaten before spoilage sets in. Preserving food also offers the opportunity to have a wide variety of foods (Disjobel USA, 2022).

Throughout history, mankind has relied heavily on the science of food preservation. People employed alternative methods to preserve perishable goods for longer periods of time before mechanical refrigeration was developed. Due to the very nutritious components of these products, fruit preservation has played a significant part in this (Disjobel USA, 2022).

The main goal of food preservation is to stop food from spoiling before it can be eaten. Gardens frequently produce more food than can be consumed before deterioration occurs. Having access to a wide variety of meals all year round is another benefit of food preservation. Whether from the market, farm, or garden, conserving money is frequently a driving force behind the decision to preserve fresh foods (Master Food Preserver, 2023). Many areas of food science, particularly food safety and preservation, have been changed by nanotechnology. Nanoparticles from a wide spectrum have been used in the food business. In addition, nanoparticles has better effects on human health than traditional methods. Nutraceuticals are more stable and bio-available, which benefits humans (Bajpai et al, 2018).

Rapid fruit ripening is a common problem of papaya production, which causes high yield losses and reduction of the marketing quality. Fruit ripening of papaya has been genetically modified by co-suppression of 1-aminocyclopropane-1-carboxylate (ACC) oxidase, which is an enzyme responsible from ethylene synthesis to extend the shelf life. Results of the studies indicated that downregulation of ACC genes generated a sharp reduction of CO2 and ethylene production. Other studies are also conducted by modifications on ethylene response factors to detect ripening related genes (Geetika et al., 2018).

The researchers found out that the conducted studies are foreign and the Carica papaya that has been tested were grown on a different type of soils, climate, and environment. The past studies lack information about zinc oxide as nanoparticle enhancing shelf-life of local Carica papaya that can be found around and within the town. The researchers had chosen Carica Papaya as the study variable because of its fast production and abundance, which sometimes was too much for people to consume and would only most likely go to waste. Also, most of the studies used fruits that can be eaten without peeling its skin off unlike the Carica Papaya that needs peeling.

The purpose of this study was to determine the effect of Zinc oxide as a nanoparticle in shelf-life enhancement of Carica papaya. The researchers opted to find out if the application of Zinc oxide as a nanoparticle will enhance the shelf-life of Carica papaya.

Statement of the Problem

Generally, this study aimed to evaluate Zinc oxide as nanoparticle as possible enhancing agent for Carica papaya

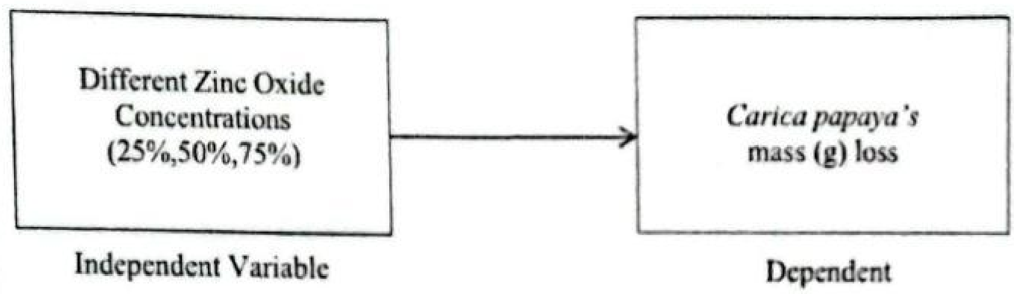
Specifically, this study sought to answer the following questions:

1. What is the effect of the different concentrations (25%, 50%, 75%) of Zinc oxide as nanoparticle in enhancing the shelf-life of Carica papaya in terms of percentage mass (g) loss ten days after the application of treatments?
2. Which concentration (25%, 50%, 75%) of Zinc oxide as nanoparticle is the most effective in enhancing the shelf-life of Carica papaya in terms of percentage mass (g) loss ten days after the application of treatments?
3. Is there a significant difference on the shelf-life of Carica papaya in terms of percentage mass (g) loss using Zinc oxide as nanoparticle ten days after the application of different concentrations (25%, 50%, 75%)?

Hypothesis

There is no significant difference on the shelf-life of Carica papaya in terms of percentage mass (g) loss using Zinc oxide as nanoparticle ten days after the application of different concentrations (25%, 50%, 75%).

Conceptual Framework



Variable Figure 1.1 Factors affecting the mass (g) loss of Carica papaya.

The independent variable of the study is the different concentrations of Zinc oxide (25%, 50%, 75%) while the dependent variable of the study as stated is the Carica papaya's mass (g) loss.

Significance of the Study

This study will benefit the following:

Store owners. This study will exhibit the ability to improve fruit's storage, reduce food waste, and preserve the quality of the stores' product.

Consumers. This study will be able to enhance the consumers' fruit's storage of shelf life in terms of mass (g) loss.

Farmers. This study will benefit farmers who seek preservatives for their Carica papaya to retain its mass (g).

Future researchers. This study will serve as reference data for future researchers

Definition of Terms

For the purpose of clarity, these key terms were defined conceptually and operationally.

Nanoparticles. These are defined as ultrafine particles sized between 1 and 100 nanometers in diameter (Mohajerani et al., 2019).

In this study, it refers to the size and classification of Zinc oxide that needs to obtain to be applied to Carica papaya.

Shelf Life. It refers as the length of time a product may be stored without becoming unsuitable for use or consumption (David Tanner, 2016).

In this study, it refers to the property of Carica papaya that needs to be enhance and preserve.

Carica papaya. Papaya is native to Central America and is grown in tropical and warmer subtropical areas worldwide. It is a large herbaceous plant, usually with a single, straight trunk which can reach to 30 feet (Sauls, 2023)

In this study, this is the dependent variable where its shelf life will enhance.

Zinc Oxide. It is a chemical compound that is made up of zinc and oxygen. It's widely used in many different industries due to its anti-bacterial and UV-blocking properties (Pub Chem, 2023).

In this study, this is the nanoparticle enhancing agent to Carica papaya.

Scope and Delimitations

This study was conducted to test the effectiveness of different concentrations of Zinc oxide (25%, 50%, 75%) as nanoparticle to enhance the shelf-life of Carica Papaya in terms of mass (g) loss. The sol gel process was performed in Cabatuan National High School Senior High School Science Laboratory while the application of treatments were conducted in Brgy. Bagacay East, Maasin, Iloilo in the month of March 2024. The materials that were used are the different laboratory apparatuses and equipment (beaker, hot plate induction, and stirring rod). This study was conducted under the supervision of a research adviser and research assistant.

CHAPTER II

REVIEW OF THE RELATED LITERATURE

This review of related feature part 1) Nanoparticle, Including its definition, benefits, and pretend stalls, B. Cars Paper, where taxonomic classification, morphological structure, distribution, health benefits and related studies were discussed, and III) Zinc oxide, where importance and related studies are presented

Nanoparticle

Definition of Nanoparticle. Nanoparticles are tiny materials having size ranges from 1 to 100 mm. They can be classified into different classes based on their properties, shapes or sizes. The different groups include fullerenes, metal NPs, ceramic NPs, polymeric NPs. NPs possess unique physical and chemical properties due to their high surface area and nanoscale size. Their optical properties are reported to be dependent on the size, which imparts different colors due to absorption in the visible region. Their reductivity, toughness and other properties are also dependent on their unique size, shape and structure. Due to these characteristics, they are suitable candidates for various commercial and domestic applications, which include catalysis, Imaging. medical applications, energy-based research, and environmental applications (Khun et al, 2019)

Benefits of Nanoparticles. The creation of nanoparticles ting technology has sparked a lot of interest in the food packaging industry. It makes a commitment to the creation of food packaging with improved qualities that aid in extending the shelf life of food goods. The most prevalent nanoparticles used in food packaging are discussed in this overview, along with the considerable changes they make to the properties of packaging materials and the range of commercially accessible nano-based packaging options. In order to maintain food quality and traceability along the supply chain, better packaging, active packaging, and intelligent packaging are developed using nanoparticles. Nanoparticles are useful for creating nanocomposites because of their antibacterial activity, capacity to scavenge oxygen, UV impermeability, and a variety of other features. a high surface area to volume ratio (Ashfaq et al., 2020).

Related Studies on Nanoparticle. One of the more exciting food advancements in recent years is edible coatings, which are thin layers of edible ingredients that are created directly on fruits, typically by submerging the fruits in a coating material solution. Edible coatings can transport nutrients, anti-browning and antimicrobial agents, flavorings, colors, and tastes, improving shelf life and limiting the growth of pathogens on food surfaces. Edible coatings can be applied using a variety of techniques, such as dipping, spraying, or coating, to control processes like moisture transfer, gas exchange, or oxidation. Nanoparticles may help to enhance the barrier properties and functionality of fruit preservation coatings since these systems have a bigger surface area (Kondle et al., 2022).

After being harvested, climatic fruit continues to ripen and release ethylene along with an increase in respiration rate, which adds to a quicker perishability. It has been demonstrated that inhibiting ethylene production is an effective strategy to put off ripening and extending shelf life. The utilization of natural ingredients, affordability, and ease of application are just a few advantages of edible coatings. Interesting methods for managing fruit shelf life after harvest are offered by nanotechnology. These specific and improved features of nanoparticles make them particularly effective at postponing fruit ripening and deterioration. The major objective of adding nanoparticles to edible coatings is to improve the mechanical and water vapour barrier qualities of the biopolymer (Odetayo, Tesfaye, & Ngobese, 2022).

According to Biswas and Wu (2012) A class of materials known as nanoparticles exhibits characteristics that set them apart from their bulk and molecular counterparts. A critical analysis of the extremely broad subject of environmental nanoparticles is presented. The review primarily focuses on gas-borne nanoparticles due to the broad nature of the subject. It traces the "life history of nanoparticles" from its creation to its potential applications and ultimate demise in the environment. The discussion includes nanoparticle origins, anthropogenic emissions from industrial and occupational contexts, as well as conversion and production in the atmosphere. It is discussed whether it is possible to characterize, trap, and manage these nanoparticles (of emissions from an industrial source), as would be necessary in a nanoparticle production system. An explanation of how nanoparticles are used in environmental technology and how they might affect the energy sector is given. Consideration must be given to the potential impacts, both positive and negative, on human health and the environment. It will be clear that the field of "environmental nanoparticles" research is young and expanding quickly.

***Carica papaya*.**

Taxonomy and Names of *Carica papaya*. The *Carica papaya*, is the most economically significant plant in the Caricaceae family and a member of the genus Carica. It is frequently referred to as "pawpaw" in Australia and as "tree melon" in some other nations, although it is distinct from the North American "pawpaw", a plant in the Annonaceae family (Abdulazeez et al, 2011).

Morphological and Structure of *Carica papaya*. Long, hollow petioles support palmately lobed leaves that can reach a width of 75 cm. The blades have conspicuous golden ribs and veins and are separated from five to nine primary segments. The inflorescences that develop in the axils of the leaves are where the flowers are born. Typically, the fruit is spherical or long, melon-like, and may have over 1000 seeds. Smooth and green at first, the skin eventually becomes yellow or orange as it ripens (Abdulazeez et al, 2011).

Distribution of Carica papaya. The Carica papaya is thought to be indigenous to tropical America, maybe from southern Mexico and neighboring Central America. In the sixteenth century, Spanish explorers brought it to the Caribbean and South East Asia. The fruit's huge quantity of seeds and their extended viability are two elements that are considered to have contributed to the fruit's widespread geographic dissemination (Singh, 2011).

Health benefits of Carica papaya. Vitamins A, C, and E, which are powerful antioxidants, are abundant in Carica papaya. Antioxidant-rich diets may lower the risk of heart disease. The antioxidants stop cholesterol from oxidizing Oxidizing cholesterol increases the risk of blockages, which result in heart disease. The high fiber content of papaya may also lower the risk of heart disease. Diets high in fiber reduce cholesterol levels. Folic acid, found in papaya, is necessary for transforming the dangerous amino acid homocysteine into other, less hazardous amino acids. Homocysteine is a risk factor for heart disease and is a common amino acid present in animal products. Consequently, include papaya in your diet may reduce homocysteine levels, thereby lowering this risk factor (Sechdev, 2022)

Related Studies on Carica papaya. The edible coating is one of the promising aspects in the preservation of climacteric fruits like papaya. Among the various edible coating, Aloe vera gel has drawn serious attention to the scientific community as one of the promising bio-preservatives due to its human health benefit and antimicrobial properties. The packaging of fruits using polythene bag is already a common practice. As a result, this study was done to determine how post-harvest ripening behaviour and physicochemical properties of papaya fruits stored at room temperature (25 2 °C and 80-85% relative humidity) would change depending on whether the fruits were wrapped in polythene that was perforated or not (Parven et al., 2020), Due to its flavour and nutritious qualities, papaya is a favourite among consumers.

This chapter discusses the value of papaya as a nutrient-dense fruit as well as techniques for extending the life of this commodity after harvest utilizing post-harvest treatments, including formulations based on the naturally occurring plant substance known as hexanal. Both in its fresh fruit form and in processed form, papaya is quickly expanding in importance as a fruit crop In the average person's diet, papaya offers an affordable source of vitamins and minerals. Due to its short shelf life after harvest, papaya is perishable. Applying the right pre- and post-harvest practices is crucial for boosting this commodity's biological stability and lengthening its shelf life (Hewajulige et al., 2018).

Vegetables and fruits are crucial components of a healthy diet. One of these is the papaya, Carica papaya, which came originally from Mexico and northern South America but has since naturalized in many other places across the world, including tropical and subtropical areas. Due to the presence of phenolics, flavonoids, and alkaloids as the main phytochemicals, papaya is renowned for a variety of health benefits including antioxidant, antibacterial, anticancer activity, anti-fertility agent, anti-inflammatory, antiulcer, antidiabetic, hepatoprotective, and many more. The review primarily focuses on the many phytochemicals that are found in various plant C sections, papaya, their pharmacological effects, and a number of additional uses. In order to write this review essay, a literature research using renowned books on fruit and medicinal plants was conducted (Sharma et al., 2020).

Zinc Oxide

Definition of Zinc Oxide. A versatile material, zinc oxide has special physical and chemical characteristics. This article's first section lists the most significant metallurgical and chemical processes for producing ZnO. Chemical methods for obtaining zinc oxide include the mechanochemical process, controlled precipitation, sol-gel method, solvothermal and hydrothermal method, method using emulsion and microemulsion environment, and other techniques (Radzimska et al., 2014).

Importance of Zinc Oxide. The function of zinc oxide nanoparticles (ZnO NPs) in plants and agriculture has garnered a lot of attention in recent years. Numerous benefits of NPs have been shown, and this beautiful material can replace numerous fertilizers, micronutrients, fungicides, and antimicrobial agents. The protective functions of many crops against abiotic stress (drought, salt, and high temperature) are particularly important (Singh et al., 2021).

Related Studies on Zinc Oxide. ZnO nanoparticles are nontoxic inorganic oxides that have been widely employed in the food industry as antibacterial agents and supplements for zine minerals, particularly in edible coatings to guard food from bacterial, fungal, and viral deterioration. SEM and X-ray diffraction were used in this study to characterise ZnO nanoparticles that were produced using a hydrothermal technique. When tested against a variety of microorganisms, including Staphylococcus aureus, Escherichia coli, and Bacillus subtilis, the produced ZnO nanoparticles showed good antibacterial capabilities. A chitosan/gum arabic (CH/GA) edible covering with ZnO nanoparticles added as an antibacterial agent was tested for its ability to prevent bananas from spoilage (La et al., 2021).

To increase the shelf life of wild-simulated Korean ginseng root (WsKG), chitosan-ZnO nanoparticle (ZnONP) edible coating was used. The 0.03% chitosan-ZnONP solution was the most effective at inhibiting both Gram-positive Bacillus cereus and Gram-negative Escherichia coli in antimicrobial testing of several coating solutions (0.01, 0.02, and 0.03% ZnONP). The edible coating of WsKG was subsequently applied using the 0.03% chitosan-ZnONP solution. The microbiological limit (4.7 * log(CFU / g)) of total aerobic bacteria for non-coated and coated WsKG was met in isothermal storage tests (temperature: 5-20 °C, RH: 95%) at 3.9 and 6.3 weeks at 5 deg * C 1.9 and 4.3. weeks at 10 deg * C and 1.3 and 2.0 weeks at 20 deg

* C respectively. At 5 deg * C mould started to appear in the non-coated sample after 4 weeks, but not in the covered sample after 6 weeks. Chitosan-ZnONP edible coating was very effective in preserving WsKG (Kang et al., 2022).

CHAPTER III

METHODOLOGY

This chapter presents the materials used and procedures employed in this study. For an overview, see Figure 2.1 Schematic Diagram of Research Methodology.

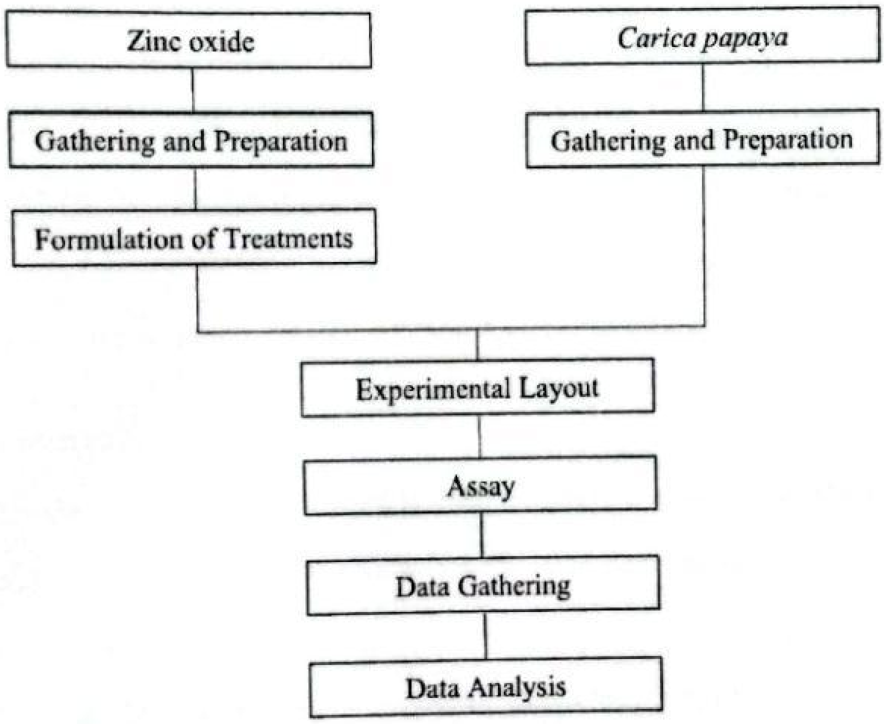


Figure 2.1. Schematic Diagram of Research Methodology

Description of Study Variables

Carica papaya. Thirty-six *Carica papaya, almost* ripe or young matured fruit were used in this study. It was ensured that the young matured fruits to be used for application of treatments are from insect bites and molds.

Zinc oxide. Sixty grams of zinc oxide were used in this study.

Gathering of Study Variables

Thirty-six young matured red lady Carica papaya were gathered by hand picked from a farm at Brgy. Salacay, Cabatuan, Iloilo and were identified by the selected farmers.

Five hundred grams of zinc acetate dihydrate, and one thousand five hundred milliliters of ethanol were purchased at D'MaLT Industrial Sales Corp.

Preparation of Materials

The Carica papaya were washed in 4000 milliliters distilled water. The washed Carica papaya were dried one by one with white clean cloth and also were placed on new white clean cloth.

While in Zinc oxide, the process started with a zine precursor, 132 g of zinc acetate dihydrate, being dissolved 500 ml of ethanol then heated and stirred at medium heat for 20 minutes. This forms a solution, or 'sol'. Once everything is mixed together, the solution is then allowed to dry for three to five days until it solidifies. This solidified mixture is then heated in an oven to the highest temperature (400°C), until it decomposes and leave behind a powdery residue of Zinc Oxide (Radzimska, 2014) The Zinc oxide powder were placed in sample bottles and ready to be used.

Formulation of Treatments

For Treatment 1 (25% of zinc oxide), 10 grams of zinc oxide were dissolved in 30 milliliters of ethanol. For Treatment 2 (50% of zinc oxide) 20 grams of zinc oxide were mixed with 20 milliliters of ethanol. For Treatment 3 (75% of zinc oxide) were serially formulated by mixing 75 grams of zinc oxide and 25 milliliters of ethanol. Three hundred milliliters of distilled water were served as treatment 4 (negative control). Each treatment 1, 2, 3, and 4 were placed on the spray container and labeled respectively.

Experimental Layout

This study had four treatments, and each treatments' setup was replicated thrice. Randomized Complete Block Design (RCBD) was used as the experimental design. The assignation of treatments were done via the lottery method.

I	II	III
T4	T3	T1
T1	T4	T2
T3	T2	T4
T2	T1	T3

Table 1.1 Experimental Layout of The Study

Legend:

T1- 25% Zinc oxide

T2 - 50% Zinc oxide

T3 - 75% Zinc oxide

T4 - Distilled water (negative control)

I - First Replication

II-Second Replication

III - Third Replication

Experimental Assay/Method

The method used to determine the difference on the the shelf-life of Carica papaya in terms of mass (g) loss using Zinc oxide as nanoparticle ten days after the application of different concentrations (25%, 50%, 75%) was based from Kondle et al (2022).

Thirty-six Carica papaya were divided into twelve groups and each group of were labeled according to the treatments and application assigned to them.

Different concentrations (25%, 50%, 75%) of Zinc oxide as nanoparticle were mixed with distilled water according to the ratio of concentrations then followed by spraying on the fruit on three replications. The fruits were then placed in a room temperature for ten days until the reading of results.

Data Gathering Procedure

The mass (g) of each *Carica papaya* were measured using digital balance before and ten days after the application of treatments. To determine the percentage mass (g) loss of each *Carica papaya*, the researchers took the differences of initial and final mass (g) over the initial mass (g) multiplied by 100.

$$\textit{Percentage mass (g) loss} = \left(\frac{W_i - W_f}{W_i} \times 100 \right)$$

Where W_i = initial *Carica papaya's* mass (g)

W_f = final *Carica papaya's mass* (g)

Data Analysis

Using Microsoft Excel, the following statistical analysis were used to represent analyze the data.

Mean. This was used to summarize the data gathered per treatments.

Standard Deviation. This was used to determine the homogeneity of results.

Data Analysis

Using Microsoft Excel, the following statistical analysis were used to represent analyze the data.

Mean. This was used to summarize the data gathered per treatments.

Standard Deviation. This was used to determine the homogeneity of results.

ANOVA. This was used to determine the significant difference in the percentage mass (g) loss of Carica papaya's shelf-life enhancement in different concentrations of zinc oxide.

DMRT. This was used to analyzed statistically the different concentrations (25%,50%,75%) of zinc oxide as nanoparticle on Carica papaya in terms of mass (g) loss ten days after the application of treatments.

CHAPTER IV

RESULTS AND DISCUSSION

This chapter presents the results obtained from the conducted experiment followed by discussion and interpretation of the said results.

Descriptive Data Analysis

Shelf-life Enhancement of Carica papaya in terms of Mass Loss using Zinc oxide as Nanoparticles

The effect of Zinc oxide as nanoparticles in enhancing the shelf-life of Carica papaya in terms of mass (g) loss was determined and recorded as shown in Table 2.1.

Result showed that among the treatments, Treatment 4 (negative control) has lower mass (g) loss than Treatment 1 (25% zinc oxide), Treatment 2 (50% zinc oxide), and Treatment 3 (75% zinc oxide) However, among the experimental treatments, Treatment 1 (25% zinc oxide) showed lower mass (g) loss which has the highest result and Treatment 3 (75% zinc oxide) has the lowest result. Furthermore, it was observed that the application of Zinc oxide showed better effects on firmness rather than mass (g) loss and only when applied with small amount.

Table 2.1 Shelf-life Enhancement of *Carica papaya* in Terms of Mass (in g) Loss using Zinc oxide as Nanoparticles Ten Days After the Application of Different Treatments

Treatment	Replication			Total	Treatment Mean	Standard Deviation
	I	II	III			
Zinc oxide (25%)	27.21	17.6	12.71	57.52	19.17	7.38
Zinc oxide (50%)	17.29	23.94	19.4	60.63	20.21	3.40
Zinc oxide (75%)	15	19.85	30.89	65.74	21.91	8.14
Negative Control (Distilled Water)	12.59	21.26	15.63	49.48	16.49	4.40

Significant Difference of Shelf-life Enhancement of *Carica papaya* in Terms of Mass (g) Loss using Zinc oxide as Nanoparticles

Table 3.1 shows that there is no significant difference between the shelf-life enhancement of the experimental and negative control treatments in terms of mass (g) loss of *Carica papaya* ten days after the application of different treatments. It implies that the result of shelf life enhancement of different concentrations of zinc oxide and the negative control are comparable with one another.

Table 3.1 Analysis on Variance of *Carica papaya* Mass (in g) Loss Ten Days After the Application of Different Treatments

ANOVA					
Source of Variation	SS	df	MS	F	p-value
Between Groups	46.39	3	15.46	0.41	0.75
Within Groups	303.27	8	37.91		
Total	349.66	11			

The results of shelf-life enhancement of *Carica papaya* using Zinc oxide as nanoparticle in terms of mass (g) loss at different percentages showed that the effects were not significantly different.

Furthermore, the results also conformed with Anugra et al., (2020), which stated that polysaccharide-based materials have weaknesses such as low water barrier and mechanical properties which may result in lower capability on preserving the specific coated fruits. Also, certain conditions need to be controlled to apply the spraying technique properly (liquid properties, operating conditions, and system conditions).

Conclusion

The researchers conclude that Zinc oxide as Nanoparticles has no significant effect in shelf-life enhancement of Carica Papaya in terms of mass (g) loss. There is no significant difference in the shelf-life Enhancement of the different concentration of Zinc Oxide as nanoparticles ten days after the application treatments.

Recommendations

The researchers recommend the significance of observing the firmness, color, and texture of Carica papaya rather than its mass (g) loss using Zinc oxide as Nanoparticles. The addition of Carica papaya treatments showed that the mass (g) loss is significantly affected by the different levels of concentration of zinc oxide. Also, the lesser amount of Zinc oxide to be applied on Carica papaya for further study is recommended. Furthermore, upon using the spraying technique, certain conditions need to be controlled to apply properly (liquid properties, operating conditions, and system conditions). This observation needs to conduct further research to validate the effectiveness in terms of mass (g) loss of Carica Papaya. Results of this study can help benefit the people in the community with locally grown Carica Papaya. This may also serve as evidence-based and fill a gap for other future researchers.

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APPENDICES

FEBRUARY 2024						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1	2	3
4	5	6	7	8 Revision of Chapter 3, Making of Timeline and Letter	9	10
11	12	13	14	15	16	17
18	19 Pre-ordering of Zinc Acetate Dihydrate and Ethanol	20	21	22	23	24
25	26	27	28	29		

APRIL 2024						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
	1	2	3 Gathering of Data and revision of paper.	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23 Interpretation of Results	24	25 Composing Chapter V	26 Finalization of Paper	27
28	29	30				

Cabatuan National Comprehensive High School
SENIOR HIGH SCHOOL DEPARTMENT
Cabatuan, Iloilo

MARCH 2024						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19 Preparation of Zinc Oxide	20	21	22	23
24 Gathering of Carica Papaya L., Calcination of Sol Gel, Formulation of Treatments	25	26	27	28	29	30
31						

Appendix C

COMPUTATIONS

Table 2.1 Shelf-life Enhancement of *Carica papaya* in Terms of Mass (g) Loss using Zinc oxide as Nanoparticles Ten Days After the Application of Different Treatments

Treatment	Replication			Total	Treatment Mean	Standard Deviation
	I	II	III			
Zinc oxide (25%)	27.21	17.6	12.71	57.52	19.17	7.38
Zinc oxide (50%)	17.29	23.94	19.4	60.63	20.21	3.40
Zinc oxide (75%)	15	19.85	30.89	65.74	21.91	8.14
Negative Control (Distilled Water)	12.59	21.26	15.63	49.48	16.49	4.40

Table 3.1 Analysis on Variance of *Carica papaya* Mass (g) Loss Ten Days After the Application of Different Treatments

ANOVA					
Source of Variation	SS	df	MS	F	p-value
Between Groups	46.39	3	15.46	0.41	0.75
Within Groups	303.27	8	37.91		
Total	349.66	11			

Plate 7. Harvesting at Brgy. Salacay, Cabatuan, Iloilo

Plaate 8. Measuring the mass.

Plate 9. Washing of *Carica papaya.*

Plate 10. Dry Cleaning of *Carica papaya.*

Plate 11. Replication I before the application of treatments.

Appendix E

PICTORIALS

Plate 1. Borrowing of tools from the chemistry lab.

Plate 2. Measuring of zinc acetate for heating.

Plate 3. Measuring of ethanol.

Plate 4. Dissolving the zinc acetate to ethanol.

Plate 5. Transferring to aluminum pan.

Plate 6. The residue after five days.

Appendix B

EXPENDITURES

Quantity	Unit	Description	Unit Cost	Total Cost
2	liters	Ethanol	Php 1120	Php 2240
500	grams	Zinc Acetate Dihydrate	Php 1800	Php 1800
1	gallons	Distilled Water	Php 86	Php 86
3	pieces	Spray Bottle	Php 35	Php 105
36	pieces	*Carica Papaya*	Php 40	Php 1440
TOTAL				**Php 5671**

Plate 12. Replication II before the application of treatments.

Plate 13. Replication III before the application of treatments.

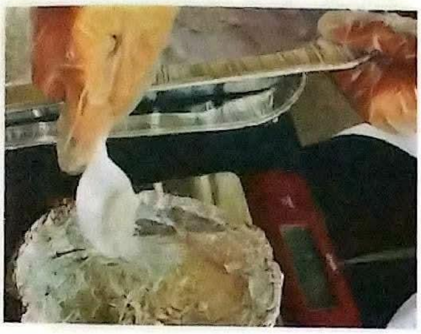

Plate 14. Measuring the residue.

Plate 15. Calcination of residue.

Plate 16. Measuring the Zinc oxide as nanoparticle.

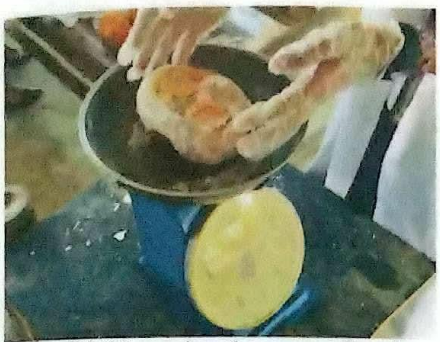

Plate 26. Measuring the mass of each *Carica papaya* gathering of results.

Plate 27. Securing the Carica papaya in a plastic bag for proper disposal.

Plate 28. The Carica papaya are now secured for proper disposal.

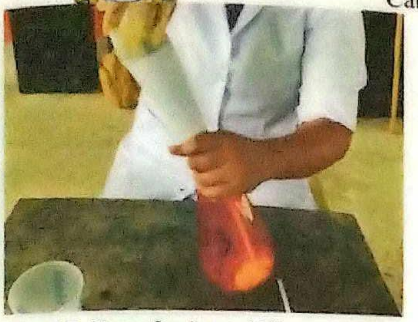

Plate 17. Transferring of Zinc oxide designated spray bottle.

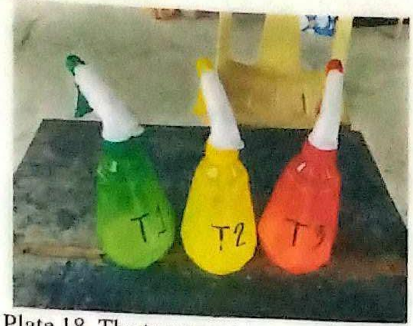

Plate 18. The treatments are ready to the for application.

Plate 19. Application of treatments using spray technique.

Plate 20. Replication I after the application of treatments

Plate 21. Replication II after the application of treatments.

Plate 22. Replication III after the application of treatments.

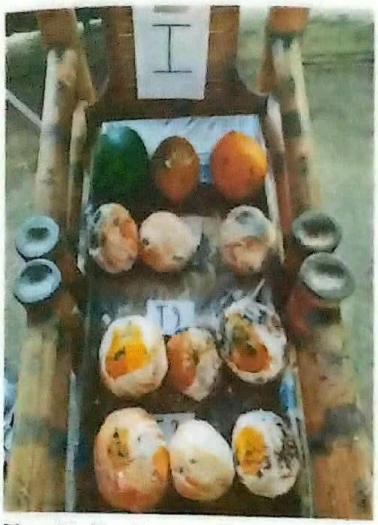

Plate 23. Replication I ten days after the the application of treatments.

Plate 24. Replication II ten days after application of treatments.

Plate 25. Replication III ten days after the application of treatments.