DISEASE OCCURENCE AND FRUIT QUALITY OF CARABAO MANGO FRUITS AS AFFECTED BY THE DIFFERENT PHYSIOLOGICAL STATUS AND POSTHARVEST TREATMENTS

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ABSTRACT

This study aimed to determine the rate of disease occurrence, and fruit quality of carabao mango fruits as affected by the different physiological status and postharvest treatments. It specifically determined the disease occurrence, and fruit quality of carabao mango fruits when treated with hot water and Zonrox after harvest. It further determined the disease occurrence, and fruit quality of carabao mango fruits at 0% flushing, 20%-50% flushing, and 75%-90% flushing as physiological status.

The independent variables in this study are the different physiological status (0% flushing, 25-50% flushing, and 75-90% flushing) and the different postharvest treatments (hot water treatment, Zonrox Dip, including the control). The dependent variables are the disease occurrence, and fruit quality of mangoes.

The researchers found that mangoes exposed to treatments lessens the occurrence of anthracnose, scabs, and stem-end rot. The least occurrence of disease was observed with fruits that undergone Zonrox Dip, due to the chemicals present in Zonrox. Zonrox is a detergent mix solution, which disinfects mangoes. The same pattern was observed among the fruits in the much lesser concentration of chemicals, i.e., in the Hot Water Treatment setup and the greatest occurrence of anthracnose, scab, and stem-end rot was observed in the control setup.

The researchers further found out that mangoes induced with chemicals, specifically KNO^3 lessens the occurrence of anthracnose, scabs, and stem-end rot. The least occurrence of disease was observed with fruits with 71-90% flushing, due to the chemicals induced. The same pattern was observed among the fruits in the much lesser concentration of chemicals, i.e., fruits with 25-50% flushing and the greatest mean rating of occurrence of anthracnose, scab, and stem-end rot was observed

among fruits with 0%flushing.

Subjected to chemicals, specifically KNO3, mango fruits have the highest mean rating of fruit quality. The highest mean rating of fruit quality of mango fruits was observed in the experimental mangoes that were treated with Zonrox Dip.

Inducing KNO_3 improved the fruit quality and resistance to the occurrence of the anthracnose and diplodia stem-end rot of carabao mango fruits. The researchers noted that flower induction may speed up the ripening of the mango fruits. It is best for mango growers to subject their trees to 75-90% flushing rather than 25-50% flushing because mango fruits that was subjected to 25-50% flushing yielded the lowest mean rating of fruit quality and lowest mean rating of the resistance to diseases.

Mango fruits subjected to treatments improved the fruit quality and resistance to anthracnose and diplodia stem-end rot of carabao mango fruits. However, when you bathe the carabao mango fruits with hot water, the fruit's resistance to anthracnose and diplodia stem-end rot will increase but it lowered the mean rating of fruit quality of fruit quality and it sped up the ripening of the fruits. But if mango growers would subject tha carabao mango fruits to Zonrox dip, it wuold increase the resistance to anthracnose and diplodia stem-end rot and still produce the highest mean rating of fruit quality of carabao mango fruits and not affect the rate of ripening of the fruits.

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Chapter 1

Introduction to the Study

Background of the Study

The mango, scientifically known as *Mangifera indica L.*, is a native fruit of Asia but is now grown in nearly all tropical and subtropical countries. The fruit's form is oval, round, heart-shaped, kidney-shaped, or long and slender. Some varieties are beautifully colored with shades of red and yellow, while others are dull green. The single large seed is flattened; the flesh that surrounds it is yellow to orange in color, juicy, and of delicious spicy flavor. It varies from a size similar to that of the apricot, to fruits weighing 4-5 pounds.

Mango is attacked by several diseases at different stages of its development, from seedling to fruit bearing. Diseases are primary constraints to production in virtually all areas where mango is grown. Scab and sooty molds are the preharvest diseases, those which occur before the fruit is even harvested, while Anthracnose and diplodia stem-end rot are the postharvest

diseases. Postharvest diseases on the other hand, occur after harvesting. (Geiy C., 1990)

Anthracnose is the most serious and widespread disease of mangoes in the Philippines. It is caused by a wet-loving fungal organism called *Colletotrichum gloeosporioides*. The fungus attacks fruits during flowering and fruit development. Fruit infection may occur at any stage of fruit development, that is, from fruit set to maturity. Upon ripening, brown to black lesions appear on the fruits, then enlarge to various sizes and shape, and become sunken as fruits fully ripen.

Diplodia stem-end rot is caused by a fungus called *Lasiodiplodia theobromae* or more commonly known as *Diplodia natalensis*. The disease can be easily distinguished by the external symptoms that normally appear as purplish discoloration at the base of the peduncle of ripening fruits. Afterwards, the basal portion turns light brown and finally turns black. As the lesion enlarges, affected pulps soften, become watery, and produce unpleasant odor. (Dr. Andam C. & Dr. Namuco L., 1999)

Fruit quality determines and identifies the salability, over-all quality and market appearance of mango fruits. As fruit size and dry matter levels peak, climacteric fruit such as mango undergo ripening: color, texture, flavor, and aroma may change. In climacteric fruit, a sharp rise, followed by a decline in respiration also accompanies the transformation from inedible (unripe), to edible (ripe), to senescent (over-ripe) (Peacock,

1986). Fully mature mango fruits are strictly those which have produced a fully developed seed and which have reached their full physiological potential for size increase and dry matter accumulation within the constraints of the growth environment.

When fruits are removed from the tree several days before the onset of ripening, they are initially hard and green. The fruit progressively soften, change color and develop aroma at a rate determined by storage environment and at-harvest maturity. (Litz R., 1998)

Flower induction is employed to cause mango trees to bloom out of season. The early 70's gave birth to the application of flower inducing chemicals (Western Visayas Region on Mango Leaflet, 1999). Through time, scores of superior yield levels were produced due to this technology. Timing of chemical induction is usually dictated by the avoidance of the rainy months to reduce risk and wastage in chemical cost. During the on-season months, which would be during March, April, and May, trees are usually induced. These months are considered to be the safest period, being before the onset of the typhoon season. However, it is also the period of highest supply and lowest price.

In induction, we use the chemical compound potassium nitrate or KNO_3. The mechanism by which KNO_3 enhances flowering in mango is unclear. There are indications however, that it acts via ethylene, a flowering hormone. A sharp increase in nitrate

reductase enzyme (NRA) activity in mango leaves occurs within twenty-four hours.

The physiological status of mangoes determines the rate by which the flower inducing chemicals or potassium nitrate (KNO_3) was applied to the mango trees. The measure depends upon the amount of flower inducing chemicals you sprayed on the tree and on the area affected by it.

In evaluating the degree or extent by which a certain mango tree is induced, we use a method where in the tree is divided into east-west quadrants. Then the tree is evaluated by the newly sprouted leaves which is a result of the potassium nitrate.

The postharvest treatments apply the principle of disinfection. Hot water treatment uses clean water of high temperature while Zonrox dip uses water with a concentration Zonrox. Since fungi mainly cause postharvest diseases, subjecting the newly harvested mango fruits to hot water treatment or Zonrox dip, disinfects or kills the fungi that are about to cause the diseases.

In this study, the researchers designed an experiment to discover which physiological status has the highest mean rating as affected by different postharvest treatments for best mango fruit produce in terms of disease occurrence and fruit quality. This design compared the quality of mango fruit samples subjected to hot water treatment, and Zonrox dip in physiological status of 0% flushing, 25-50% flushing, and 75-90% flushing of mango trees

from the National Mango Research Development Center orchard. It helped the researchers to determine which condition had the highest mean rating in terms of fruit quality as well as low occurrence of postharvest diseases such as anthracnose and diplodia stem-end-rot.

The independent variables in this study were the different physiological status (0% flushing, 25-50% flushing and 75-90% flushing) and the different postharvest treatments (hot water treatment, Zonrox dip, including the control). The dependent variables were the disease occurrence, maturity and fruit quality of mangoes.

The relationship between variables is presented in Figure 1.

INDEPENDENT VARIABLE DEPENDENT VARIABLE

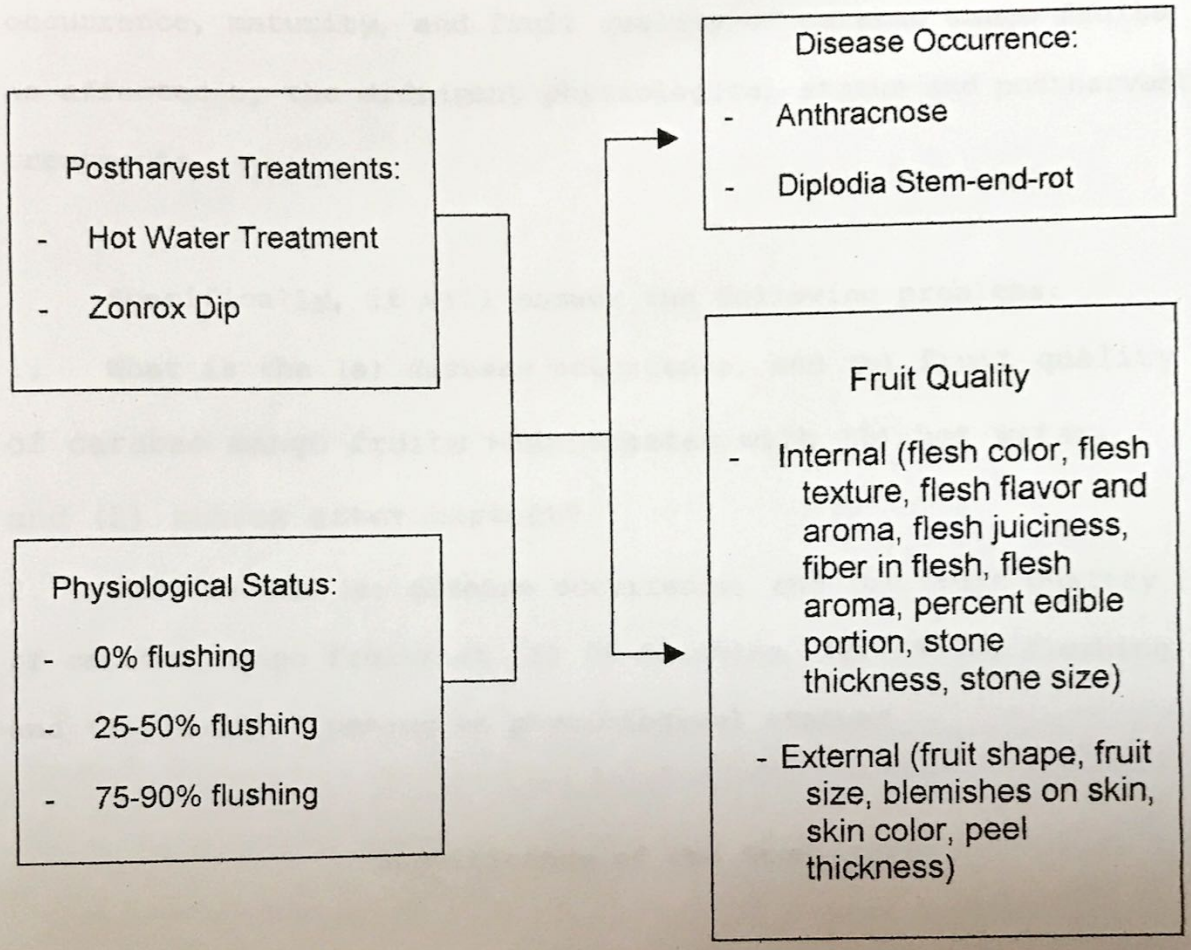

Figure 1. Disease occurrence, maturity, and fruit quality of carabao mango fruits as affected by the different physiological status and postharvest treatments.

Statement of the Problem and Hypothesis

This study aimed to determine the rate of disease occurrence, maturity, and fruit quality of carabao mango fruits as affected by the different physiological status and postharvest treatments.

Specifically, it will answer the following problems:

1. What is the (a) disease occurrence, and (b) fruit quality of carabao mango fruits when treated with (1) hot water, and (2) zonrox after harvest?
2. What is the (a) disease occurrence, and (b) fruit quality of carabao mango fruits at (1) 0% flushing, (2) 25-50% flushing, and (3) 75-90% flushing as physiological status?

Significance of the Study

The results of our study will be beneficial to farmers especially on mango growers, retail fruit vendors, and to the consumers as well.

Knowing the effects of the different physiological status and postharvest treatments on the rate of disease occurrence, maturity, and fruit quality will enable farmers to gain enough knowledge on how to produce better yields and prevent wastage of

produce. Less wastage of produce will help them gain more profit.

Consumers would also know the right mangoes to buy (mangoes having no diseases). And also for them to understand why the fruit vendors have to sell the mangoes on such prices because when mangoes ripen, they undergo weight loss.

Definition of Terms

The following terms used in this study were given their respective conceptual and operational meanings.

Disease occurrence - is the occurrence of any impairment of normal physiological function affecting an organism, especially a change caused by infection, stress, etc., producing characteristic symptoms (Collins Concise Dictionary, 1999).

In this study, the term "disease occurrence" is narrowed down to the occurrence of anthracnose and stem-end-rot on harvested mango fruits.

Induction - is the act of causing or bringing on or about (Merriam Webster's Collegiate Dictionary, 1993).

In this study, the word 'induction' refers to the process by which mango trees are being sprayed with potassium nitrate for the flowering of mango trees to produce an abundant supply of mango fruits.

Quality - is showing or having excellence or superiority

(Collins Concise Dictionary, 1999).

In this study, the term "quality" will be carrying its dictionary meaning. It will be rated through identifying the fruit's shape, weight, peel and flesh color, acidity, smoothness, and the fruit's fibers.

Mango - is a tropical fruit commonly with a yellowish red skin, hard central stone and juicy aromatic pulp (Merriam Webster's Collegiate Dictionary, 1993).

In this study, the term "mango" will be carrying its dictionary meaning. Specifically, the variety that we will be holding our tests with are carabao mangoes.

[Physiological] status - is the relative position or standing of a person of thing (Collins Concise Dictionary, 1999).

In this study, the term "physiological status" will refer to the different percentage or rate of flushing done on the mango trees such as: 0% flushing, 25-50% flushing, and 75-90% flushing.

[Postharvest] treatment - is the act, practice, or manner of subjecting to a process or to the application of a substance (Collins Concise Dictionary, 1999).

In this study, the term "postharvest treatment" will refer to the treatments that the freshly harvested carabao mangoes were subjected to. These were hot water treatment, zonrox dip, and including the control.

Scope and Delimitation of the Study

This experiment was conducted using carabao mango fruits from the orchard of the National Mango Research and Development Center in San Miguel, Jordan, Guimaras. Mangoes from Guimaras were considered. Guimaras is popular of its high quality produce of mango fruits. The sample fruits were taken from 3 trees differing in physiological status from one another. Forty-five sample fruits were randomly taken from each tree. The fruits were taken after 117 days of induction. Fifteen fruit samples were subjected to different postharvest treatments and were divided to 3 sets or replications.

The independent variables in this study were the different physiological status (0% flushing, 25-50% flushing and 75-90% flushing) and the different postharvest treatments (hot water treatment, Zonrox dip, including the control). The dependent variables were the disease occurrence, maturity and fruit quality of mangoes.

The mangoes were subjected to hot water treatment and zonrox dip. The observation period of the experiment was conducted for 10 days. All the fruits had ripened then and were dissected.

Chapter 2

Review of Related Literature

This chapter consists of six topics, namely, (1) Disease Occurrence, (2) Flower Induction, (3) Physiological Status of Mangoes, (4) Postharvest Treatments, (5) Fruit Maturity, and (6) Fruit Quality.

Disease Occurrence

Mango is attacked at different stages of its development, from seedling to fruit bearing (Field Evaluation of Tilt 250 EC for the Control of Anthracnose in Mango, 1990). Mango, *Mangifera Indica L.*, is affected by diverse decline syndromes. Fungi are the most common causal agents, and in most situations a single species is indicted. In addition, abiotic factors, such as poor host nutrition or water stress, are reported to be predisposing of causal factors in many areas (Proceedings of the Fifth International Symposium in Australia, 1996).

Diseases are primary constraints to production in virtually all areas where mango is grown. The occurrence and severity of these problems is influenced in a major way by environment. In humid regions, anthracnose is most destructive, and other

diseases including bacterial black spot, blossom blight, and stem-end rot, can also be significant problems (7th International Mango Symposium, 1998).

Anthracnose is the most serious and wide spread disease of mangoes in the Philippines. The affected young fruits remain stunted and when infected early, fall off. On the other hand black spots that develop on the skin of mature fruits are sunken and gradually coalesce to cover large area (Mango, 1990). It is caused by a wet-loving fungal organism (*Colletotrichum gloeosporioides*). The fungus attacks fruits during flowering and fruit development. Fruit infection may occur at any stage of fruit development, that is from fruit set to maturity. Upon ripening, brown to black lessions appear on the fruits, then enlarge to various sizes and shapes, and become sunken as fruits fully ripen (Anonymous, 2002). Infection on large fruits however does not immedaitely lead to lessions (Peterson, 1986) but as the pathogen becomes arrested after, formation of appresorium have following limited colonization of the mango tissue by infected hyphae.

Diplodia stem-end rot, on the other hand, is caused by a fungus [*Lasiodiplodia theobromae* (*Diplodia natalensis*)], which affects injured areas on the skin or stem (Anonymous, 2002). The

disease can be easily distinguished by the external symptoms that normally appear as purplish discoloration at the base of the penucle of ripening fruits. Soon, the basal portion turns light brown and finally turns black as the lesion enlarges, affected pulps soften, become watery, and produce unpleasant odor.

Mango scab is caused by a fungus [*Sphaceloma mangifera* (*elsinoe mangifera*)] that normally affects the appearance of the fruits. It attacks leaves, flowers, fruits and twigs similar to what the anthracnose infects (Anonymous,2002). In young fruits, infection appears as grayish brown spot with dark irregular margin. As the infected fruits develop, spots enlarge and these surfaces become covered with cracks or fissured corky tissues. The spots are usually skin deep.

Sooty mold is caused by species of sooty molds (*Capnodium mangifera and C. ramosum*). The disease is commoly observed on mango whenever honey dew-secreting insects such as leafhopper, scale insects, and mealy bugs are prevalent. Sooty mold can be easily recognized by the presence of black velvety covering on leaves and fruits. They also stain the fruits, rendering them unsightly and unattractive. Without honeydew, the casual fungi will have no food to support their development (Mango Production manual, 1999).

Scale, mealbugs and mites are frequent pests in the greenhouse and orchard. In the greenhouse, thrips often turn leaves rusty brown. Malathion is the conventional spray for insect pests; sulfur works on mites. Gophers are attracted to the roots. The flower panicles, young fruit and leaves are subjected to powdery mildew (*Oidium magnifera*), especially in rainy weather or frequent fog. A spray of powdered kelp at bud break will often control it. Sodium bicarbonate and fungicide sprays are also effective.

Bacterial spot (*Colletotrichum oleosporides*) distorts and turns developing leaves black and disfigures developing fruit. Infection may spread to fresh young growth. Anthracnose can be controlled with bimonthly applications of copper spray or captan as a growth flush begins, and until the flowers open. Resume spraying when the fruits begin to form. Mango trees are very sensitive to root loss that can occur from digging, transplanting or gopher damage. " Soft nose," a physical disorder of shriveling at the fruit apex, seems associated with excessive nitrogen in the soil. Exposed Fruits sunburn in high temperatures (Roberts, 1999).

If the mere presence of pests and diseases is the cause of production constriction, then there is enough reason to believe

that mango production is significantly reduced by pests and diseases (1995 Mango Census: Province of Guimaras, 1997).

Flower Induction

Flower induction is employed to cause mango trees to bloom out of season. The early 70's gave birth to the application of flower inducing chemicals (The Mango, Botany, Production and Uses, 1998). Through time, scores of superior yield levels were produced due to this technology. Timing of chemical induction is usually dictated by the avoidance of the rainy months to reduce risk and wastage in chemical cost. During the on-season months, which would be during March, April, and May, trees are usually induced. These months are considered to be the safest period, being before the onset of the typhoon season. However, it is also the period of the highest supply and lowest price. An example of an inducing chemical is KNO_3.

The mechanism by which KNO_3 enhances flowering in mango is unclear. There are indications however, that it acts via ethylene, a flowering hormone. A sharp increase in nitrate enzyme (NRA) activity in mango leaves occurs within twenty-four hours.

Physiological Status of Mangoes

The physiological status of mangoes determines the rate by which the flower inducing chemicals or potassium nitrate (KNO_3) was applied to the mango trees. The percentage depends upon the amount of flower inducing chemicals sprayed on the tree and on the area affected by it.

An experimental tree is divided into four quadrants. The tree is said to have undergone 20-50% flushing if nearly one to two of the quadrants had been sprayed with KNO_3. It is said to have undergone 75-90% if three or nearly four quadrants had been sprayed with KNO_3. The tree that has not been induced with KNO_3 is said to have undergone 0% flushing.

Postharvest treatments

The postharvest treatments apply the principle of disinfection. Hot water treatment uses clean water high temperature while Zonrox dip uses water with concentrations of substances found in Zonrox. Since fungi mainly cause postharvest diseases, subjecting the newly harvested mango fruits to hot water treatment or Zonrox

dip, disinfects or kills the fungi that are about to cause diseases.

Hot water treatment can damage the quality and proved to be ineffective in disinfecting mangoes of the weevil on cultivar Alphonso from India according to the result of one study (Shukla and Tardom, 1997).

Zonrox dip is done by a solution of water and detergent mix. Detergent mix was known to dilute latex (Bagshaw, and Brown, 1989 as cited by Litz, 1997). This treatment, based on one research study in Australia proved a reduction in the severity of sap burns (Johnson, 1997).

Fruit Maturity and Quality

Peacock (1986) considered that the fruit maturity referred to the stage of ontogeny at any given time, fruit of different maturities being at different stages of ontogeny as fruit size and dry matter levels peak, climacteric fruit such as mango undergo ripening: colour, texture, flavour, and aroma may change (Watada, 1984). In climacteric fruit, a sharp rise followed by a

decline in respiration also accompanies the transformation from inedible (unripe), to edible (ripe), to senescent (over-ripe) (Watada, 1984). Fully mature mango fruit are strictly those which have produced a fully developed seed and which have reached their full physiological potential for size increase and dry matter accumulation within the constraints of the growth environment.

When fruits are removed from the tree several days before the onset of ripening, they are initially hard and green. The fruit progressively soften, change its colour, and develop arome at a rate determined by storage environment and at-harvest maturity. More mature fruit will ripen more rapidly than less mature fruit (The Mango, Botany, Production and Uses, 1998).

Mango varies from a size similar to that of the apricot to fruits weighing 4-5 pounds (1.8-2.3 kg) (Collier's Encyclopedia, 1981). The form is oval, round, heart-shaped, kidney-shaped, or long or slender. Some varieties are beautifully colored with shadea of red and yellow, while others are dull green. The single large seed is flattened, the flesh that surrounds is yellow to orange in color, juicy and of delicious spicy flavor (Encyclopedia Britannica, 1972).

In the world of mangoes, there are two main kinds: green and ripe. Both are delicious, but they have very different uses. Green mangoes refer to young fruit, usually pale green, without a hint of color; crisp, with a sour taste, although sometimes sweet and sour.

Summary

Mango is attack by different stages of its development, from seedling to fruit bearing (Field Evaluation of Tilt 250 EC for the Control of Anthracnose in Mangoes, 1990). Mango, *Magnifera Indica L.*, is affected by diverse decline syndrome, Fungi are the most common causal agents, and in most situations a single species in indicted.

Anthracnose is the most destructive, and the other disease including bacterial blackspot, blossom blight, and stem-end rot, can also be significant problems.

Postharvest treatments are applied to lessen the occurrence of disease among mangoes. Good-quality mangoes are those mangoes which are disease-free.

Chapter 3

Research Design and Methodology

This study aimed to determine the rate of disease occurrence, maturity, and fruit quality of carabao mango fruits as affected by the different physiological status and postharvest treatments. It specifically determined the disease occurrence, maturity, and fruit quality of carabao mango fruits when treated with hot water and zonrox after harvest. It further determined the disease occurrence, maturity, and fruit quality of carabao mango fruits at 0% flushing, 25-50% flushing, and 75-90% flushing as physiological status.

Research Design and Methodology

The One Group Pretest-Posttest study in a completely randomized design determined the rate of disease occurrence, maturity, and fruit quality of carabao mango fruits as affected by the different physiological status and postharvest treatments.

In this study, the researchers designed an experiment to determine which physiological status is best affected by different postharvest treatments for the best mango fruit uality in terms of disease occurrence, maturity, and fruit quality. This design compared the quality of mango fruit samples subjected to hot water and zonrox dip in physiological status (0% flushing,

25-50% flushing, and 75-90% flushing) of mango trees from the National Mango Research and Development Center orchard. It helped the researchers determine which condition had the best fruit quality as well as low occurrence of postharvest diseases.

Tree selection

Experimental trees were identified based on the rate of flushing intensity. Fruit-bearing mango trees without flush, with 25-50% flushing, and 75-90% flushing were selected and were subjected to the different treatments. To ensure homogeneous results only one tree per treatment were used.

treatment were used.

Fruit sampling

At harvest, 117 days after induction, 15 fruit samples were taken randomly per treatment per tree. Fruits were brought to the laboratory. Each fruit is properly segregated and labeled corresponding to which physiological status it belongs and to what treatment it has to undergo.

Floatation method

A salt solution was prepared. Ten liters of water was measured and was placed in a plastic container. One hundred grams of salt was dissolved in the water. To test the maturity

of the fruit, the floatation method was used. Five to ten mangoes were submerged at a time. Mature mango fruits sunk when placed in the solution while immature mango fruits floated. In our study, we used mature mango fruits.

Treatment application

Mango fruits were subjected to different postharvest treatments right after harvest. The postharvest treatments are as follows:

Hot water treatment. Hot water bath was prepared. Twenty liters of water was placed in the hot water bath machine. It was heated until the temperature of the hot water would be 52 degrees Celsius. The mangoes were placed inside a screen bag and were submerged in the hot water bath for fifteen minutes. The mangoes should not touch the bottom of the hot water bath machine. After the application of the hot water treatment, the mangoes were placed in running water so as to cool them down and were air-dried.

Zonrox dip. Zonrox solution was prepared. Five hundred mL of zonrox was mixed to ten liters of water. The experimental mangoes were placed inside a screen bag and submerged into the zonrox solution for fifteen minutes. After the application of the zonrox dip treatment, the experimental mangoes were air-dried.

Control. forty-five experimental mango fruits were not

subjected to any of the two treatments.

Fruit Evaluation

Experimental mangoes were observed for several weeks or until maturity. The researchers evaluated the following data based on the given scale of the NMRDC. Data gathered were subjective (depends on the evaluator).

The following data were obtained daily at around 10 to 11 in the morning:

- Peel Color - the color of the skin of the mango
  - based on the standard Peel Color Index for mangoes (PCI).

Peel Color Index for carabao mangoes (*Mangifera Indica L.)*

Color Index Rating	External Color
1	green
2	trace of yellow (stem end)
3	more green than yellow
4	more yellow than green
5	trace of green
6	full yellow

subjected to any of the two treatments.

Fruit Evaluation

Experimental mangoes were observed for several weeks or until maturity. The researchers evaluated the following data based on the given scale of the NMRDC. Data gathered were subjective (depends on the evaluator).

The following data were obtained daily at around 10 to 11 in the morning:

- Peel Color - the color of the skin of the mango
  - based on the standard Peel Color Index for mangoes (PCI).

Peel Color Index for carabao mangoes (*Mangifera Indica L.)*

Color Index Rating	External Color
1	green
2	trace of yellow (stem end)
3	more green than yellow
4	more yellow than green
5	trace of green
6	full yellow

- Disease Occurrence Rating – the disease occurrence rating of the fruit : anthracnose and stem-end rot were monitored.

Rating	Severity
1	no infection
2	less than 1%
3	1-5% infection
4	6-10% infection
5	11-20% infection
6	21-30% infection
7	31-40% infection
8	41-50% infection
9	51-60% infection
10	more than 60% infection

- Fruit Quality. Fruit evaluation (also coined as destructive sampling) of the internal and external qualities of carabao mangoes was done if the mangoes reached the peel color rating of 6 as full yellow based on the peel color index.

a.) External Qualities such as:

a.1 shape

Well-formed	5
Fairly formed	3
Off=shaped	1

a.2 size

Large (290 g or more)	7
Medium (241-290g)	5
Small (190-240g)	3
Very Small (less than 190g)	1

a.3 blemishes on skin

Severe	5
Moderate	3
None to scanty	1

a.4 skin color

Yellow orange	5
Yellow	3
Light yellow	1

a.5 peel thickness

Thick (more than 1.2 cm)	5
Intermediate (0.8-1.2cm)	3
Thin (less than 0.8cm)	1

b.) Internal qualities such as:

b.1 flesh color

Yellow orange	5
Yellow	3
Light yellow	1

b.2 flesh texture

Smooth, firm	5
Intermediate	3
Course and soggy	1

b.3 flesh flavor and aroma

Sub-acid to sweet (18° Brix and above)	10-15
Moderate (15-17° Brix)	7-9
Flat (14° Brix and below)	1-6

b.4 flesh juiciness

Very juicy	5
Moderate	3
Dry	1

b.5 fiber in flesh

Abundant	5
Moderate	3
None to scanty	1

b.6 flesh aroma

Strong	5
Mild	3
Weak	1

b.7 percent edible portion

High (more than 75%)	5
Intermediate (70-75%)	3
Low (less than 70%)	1

b.8 stone thickness

Thick (more than 20mm)	5
Intermediate (15-20mm)	3
Thin (less than 15mm)	1

b.9 stone size

Large (more than 35g)	5
Intermediate (26-35g)	3
Small(less than 26g)	1

Chapter 4

Results

This study aimed to determine the rate of disease occurrence, and fruit quality of carabao mango fruits as affected by the different physiological status and postharvest treatments. It specifically determined the disease incidence, and fruit quality of carabao mango fruits when treated with hot water and Zonrox after harvest. It further determined the disease occurence, and fruit quality of carabao mango fruits at 0% flushing, 20%-50% flushing, and 75%-90% flushing as physiological status.

Disease occurrence of carabao mango fruits when treated with hot water and Zonrox after harvest

There was a marked decrease in the rate of disease occurrence in the mango fruits that were treated in the different setups after 117 days after harvest. The rate of occurrence of scab in the mango fruits had the highest mean rating in the control setup or with the fruits that were not exposed to any treatments (mean of 4.21) and had the least mean rating in the Zonrox Dip set-up (mean of 2.89).

Anthracnose also infected some of the experimental fruits. The rate of occurrence of anthracnose in the mango fruits had the highest mean rating in the control setup (mean of 5.42) and had the least mean rating in the Zonrox Dip setup (mean of 3.23).

There was also an occurrence of stem-end rot found in the experimental mango fruits. The rate of occurrence of anthracnose in the mango fruits had the highest mean rating in the Hot Water Treatment setup (mean of 4.35) and had the least mean rating in the Zonrox Dip setup (mean of 3.48).

This showed that mangoes exposed to treatments lessens the occurrence of anthracnose, scabs, and stem-end rot. The least occurrence of disease was observed with fruits that undergone Zonrox Dip, due to the chemicals present in Zonrox. Zonrox is a detergent mix solution, which disinfects mangoes. The same pattern was observed among the fruits in the much lesser concentration of chemicals, i.e., in the Hot Water Treatment setup and the greatest occurrence of anthracnose, scab, and stem-end rot was observed in the control setup.

Table 1 shows the data.

Table 1.

Disease occurrence of carabao mango fruits when treated with hot water and Zonrox dip

Disease	Treatments					
	Hot Water Treatment		Zonrox Dip		Control	
	Mean rating	Description	Mean rating	Description	Mean rating	Description
Scab	3.85	6-10% of surface area infected	2.89	1-5% of surface area infected	4.21	6-10% of surface area infected
Anthracnose	3.94	6-10% of surface area infected	3.23	1-5% of surface area infected	5.42	6-10% of surface area infected
Stem-end rot	4.35	6-10% of surface area infected	3.48	1-5% of surface area infected	4.33	6-10% of surface area infected

Fruit Quality of carabao mango fruits when treated with hot water and Zonrox after harvest

Treatment application greatly affects the fruit quality of mango fruits. There was a marked increase in the fruit quality of fruits due to the exposure to different treatments.

The rating of fruit shape was highest in the Zonrox Dip setup (mean of 4.39) and was least in the control setup (mean of 4.21).

The rating of fruit size was highest in the Zonrox Dip setup (mean of 5.53) and was least in the control setup (mean of 5.42).

The rating of blemishes on skin was highest in the hot water treatment setup (mean of 2.89) and was least in the Zonrox Dip setup (mean of 1.97).

The rating of skin color was highest in the Zonrox Dip setup (mean of 4.62) and was least in the control setup (mean of 3.85).

The rating of peel thickness was highest in the hot water treatment setup (mean of 3.25) and was least in the Zonrox Dip setup (mean of 3.12).

The rating of flesh color was highest in the Zonrox Dip setup (mean of 4.85) and was least in the control setup (mean of 4.71).

The rating of flesh texture was highest in the Zonrox Dip setup (mean of 4.85) and was least in the control setup (mean of 4.71).

The rating of flesh flavor was highest in the Zonrox Dip setup (mean of 14.65) and was least in the hot water treatment setup (mean of 4.21).

The rating of flesh juiciness was highest in the Zonrox Dip setup (mean of 4.21) and was least in the hot water treatment setup (mean of 3.25).

The rating of fiber in flesh was highest in the control setup (mean of 1.32) and was least in the Zonrox Dip setup (mean of 1.17).

The rating of flesh aroma was highest in the control setup (mean of 3.52) and was least in the Zonrox Dip setup (mean of 3.41).

The rating of percent edible portion was highest in the Zonrox Dip setup (mean of 4.93) and was least in the control setup (mean of 4.56).

The rating of stone thickness was highest in the hot water treatment setup (mean of 2.89) and was least in the Zonrox Dip setup (mean of 2.57).

The rating of stone size was highest in the hot water treatment setup (mean of 2.87) and was least in the Zonrox Dip setup (mean of 2.61).

This showed that subjected to chemicals, specifically KNO3, mango fruits had the highest mean rating of fruit quality. The highet mean rating of fruit quality of mango fruits was observed in the experimental mangoes that were treated with Zonrox Dip. Table 2 shows the data.

Table 2.

Fruit Quality of carabao mango fruits when treated with hot water and Zonrox dip

Quality	Treatments					
	Hot Water Treatment		Zonrox Dip		Control	
	Mean rating	Description	Mean rating	Description	Mean raing	Description
Shape	4.36	Fairly formed	4.39	Fairly formed	4.21	Fairly formed
Size	6.25	Large	5.53	Medium	5.42	Medium
Blemishes on skin	2.89	Moderate	1.97	None to Scanty	2.33	Moderate
Skin color	4.53	Yellow orange	4.62	Yellow orange	3.85	Yellow orange
Peel Thickness	3.25	Intermediate	3.12	Intermediate	3.19	Intermediate
Flesh Color	4.78	Yellow Orange 4.85		Yellow Orange	4.71	Yellow Orange
Flesh Texture	4.43	Smooth and firm 4.46		Smooth and firm	4.14	Smooth and firm
Flesh Flavor	14.35	Sub-acid to sweet 14.65		Sub-acid to sweet	14.53	Sub-acid to sweet
Flesh Juiciness	3.25	Moderate 4.21		Very juicy	3.96	Very juicy
Fiber in flesh	1.26	None to scanty 1.17		None to scanty	1.32	None to scanty
Flesh Aroma	3.44	Mild 3.41		Mild	3.52	Strong
Percent Edible Portion	4.87	High 4.93		High	4.56	High
Stone Thickness	2.89	Intermediate 2. 57		Intermediate	2.68	Intermediate
Stone Size	2.87	Intermediate	2.61	Intermediate	2.66	Intermediate

Disease occurrence of carabao mango fruits when treated with different physiological status

There was a marked decrease in the rate of disease occurrence in the mango fruits that gone different rates of flower induction before harvest.

The rating of disease occurrence of scab was highest in the fruits with 25-50% flushing (mean of 4.21) and was least in the fruits with 70-90% flushing (mean of 2.87).

Anthracnose also infected some of the experimental fruits. The rating of disease occurrence of scab was highest in the fruits with 0% flushing (mean of 3.97) and was least in the fruits with 70-90% flushing (mean of 3.16).

There was also an occurrence of stem-end rot found in the experimental mango fruits. The rating of disease occurrence of scab was highest in the fruits with 0% flushing (mean of 4.11) and was least in the fruits with 70-90% flushing (mean of 3.44).

This showed that mangoes induced with chemicals, specifically KNO^3 lessens the occurrence of anthracnose, scabs, and stem-end rot. The least occurrence of disease was observed with fruits with 71-90% flushing, due to the chemicals induced. The same pattern was observed among the fruits in the much lesser concentration of chemicals, i.e., fruits with 25-50% flushing and

the greatest mean rating of occurrence of anthracnose, scab, and stem-end rot was observed among fruits with 0%flushing.

Table 3 shows the data.

Table 3.

Disease occurrence of carabao mango fruits with different physiological status

Disease	Treatments					
	0% flushing		25-50% flushing		75-90% flushing	
	Mean	Description	Mean	Description	Mean	Description
Scab	3.62	6-10% of surface area infected	4.21	6-10% of surface area infected	2.87	1-5% of surface area infected
Anthracnose	3.97	6-10% of surface area infected	3.82	6-10% of surface area infected	3.16	1-5% of surface area infected
Stem-end rot	4.11	6-10% of surface area infected	3.84	6-10% of surface area infected	3.44	1-5% of surface area infected

Fruit Quality of carabao mango fruits with different phsiological status

Flower induction greatly affects the fruit quality of mango fruits. There was a marked increase in the fruit quality of fruits due to the induction of chemicals.

The rating of fruit shape was highest in the fruits with 75-90% flushing (mean of 4.44) and was least in the fruits with 0% flushing (mean of 4.26).

The rating of fruit size was highest in the fruits with 75-90% flushing (mean of 6.29) followed by fruits with 0% flushing (mean 5.48). The rating of fruit size of mangoes was observed to be least in the fruits with 25-50% flushing (mean of 5.34).

The rating of blemishes on skin was highest fruits with 0% flushing (mean of 2.19) and was least in the fruits with 25-50% flushing (mean of 1.97).

The rating of skin color was highest fruits with 75-90% flushing (mean of 4.85) and was least in the fruits with 0% flushing (mean of 3.83).

The rate of peel thickness was highest fruits with 0% flushing (mean of 3.15) and was least in the fruits with 75-90% flushing (mean of 3.04).

The rating of stone thickness was highest fruits with 25-50% flushing (mean of 2.77) and was least in the fruits with 75-90% flushing (mean of 2.45).

The rating of stone size was highest fruits with 0% flushing (mean of 2.72) and was least in the fruits with 75-90% flushing (mean of 2.54).

This showed that subjected to chemicals, specifically KNO3, mango fruits have the highest mean rating of fruit quality. The highest mean rating of fruit quality of mango fruits was observed in the experimental mangoes that were treated with Zonrox Dip.

Table 4 shows the data.

Table 4.

Fruit Quality of carabao mango fruits at different physiological status

Quality	Treatments					
	0% flushing		20-50% flushing		75-90% flushing	
	Mean rating	Description	Mean rating	Description	Mean rating	Description
Shape	4.26	Fairly formed	4.38	Fairly formed	4.44	Fairly formed
Size	5.48	Medium	5.34	Medium	6.29	Large
Blemishes on skin	2.19	Moderate	1.97	None to Scanty	2.06	None to Scanty
Skin color	3.83	Yellow orange	3.92	Yellow orange	4.85	Yellow orange
Peel Thickness	3.15	Intermediate	3.12	Intermediate	3.04	Intermediate
Flesh Color	4.77	Yellow Orange 4.74		Yellow Orange	4.87	Yellow Orange
Flesh Texture	4.43	Smooth and firm 4.36		Smooth and firm	4.44	Smooth and firm
Flesh Flavor	14.35	Sub-acid to sweet 14.55		Sub-acid to sweet	14.63	Sub-acid to sweet
Flesh Juiciness	3.97	Moderate 4.03		Very juicy	4.18	Very juicy
Fiber in flesh	1.32	None to scanty 1.25		None to scanty	1.14	None to scanty
Flesh Aroma	3.44	Mild 3.46		Mild	3.51	Strong
Percent Edible Portion	4.81	High 4.83		High	4.96	High
Stone Thickness	2.69	Intermediate 2. 77		Intermediate	2.45	Intermediate
Stone Size	2.72	Intermediate	2.60	Intermediate	2.54	Intermediate

Chapter 5

This study aimed to determine the rate of disease occurrence, maturity, and fruit quality of carabao mango fruits as affected by the different physiological status and postharvest treatments.

Specifically, it answered the following problems:

1. What is the (a) disease occurrence, and (b) fruit quality of carabao mango fruits when treated with (1) hot water, and (2) zonrox after harvest?
2. What is the (a) disease occurrence, and (b) fruit quality of carabao mango fruits at (1) 0% flushing, (2) 25-50% flushing, and (3) 75-90% flushing as physiological status?

Summary

The findings of this study is summarized as:

1. The disease occurrence was higher in terms of the mean when the carabao mangoes were not introduced to any treatment and it occurred the least when the carabao mango fruits were subjected to zonrox dip.
2. The disease occurrence was greater in terms of the mean when the carabao mangoes were induced with 25 - 50%

flushing and it occurred the least when the carabao mango fruits were induced with 75 - 90% flushing.

3. The fruit quality of the carabao mango fruits was the highest in terms of the mean when subjected to hot water treatment and it was the least when the fruits were not subjected to any treatment.
4. The fruit quality of the carabao mango fruits was the highest in terms with the mean when induced with 75 - 90% flushing and it was the least when the fruits were induced with 25 - 50% flushing.

Conclusion

The results of flower induction had the greatest mean rating in terms of the fruit quality and resistance to anthracnose and diplodia stem-end rot of carabao mango fruits. In accordance with the mean from our results, if you subject the carabao mango tree to 75 - 90% flushing rather than 25 - 50% flushing, it would yield a higher mean rating in terms of fruit quality and lower mean rating in occurrence of diseases.

The subjected carabao mango fruits to treatments yielded the highest mean rating in terms of the fruit quality and resistance to anthracnose and diplodia stem-end rot of carabao mango fruits. When you treat the carabao mango fruits with hot water treatment, the mean rating in terms of the fruit's

resistance to anthracnose and diplodia stem-end rot is higher. If you subject the carabao mango fruits to zonrox dip, it will also increase the mean rating in terms of the resistance to anthracnose and diplodia stem-end rot and still produce the a high mean rating in terms of the fruit quality of carabao mango fruits.

Recommendation

According to the mean of our results, subjecting carabao mango fruits to zonrox dip right after harvesting did not only increased the mean rating in terms of the resistance from disease occurrence but also had the highest mean rating in terms of the carabao mango fruits' quality.

The researchers also recommend inducing the mango tree with 75 - 90% flushing instead of just 25 - 50% flushing because fruits taken from mango trees that were induced with 75 - 90% flushing produced carabao mango fruits with better quality and higher resistance to disease.

In selling the fruits, it is better if the fruits do not quickly ripen so that it will not of go rotten extensively. To avoid hastening the fruit's ripening, do not subject them to hot water treatment but to zonrox dip instead, because the zonrox dip treatment is more advantageous.

The researchers would also recommend that if this study were conducted again, the researchers should take more random samples from each tree so that their results become more reliable.

The researchers also recommend the application of statistical analysis in evaluating the results gathered in this study to have a much more dependable result to base the analysis on.

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Background Information

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APPENDIX A

STANDARD PROCEDURES

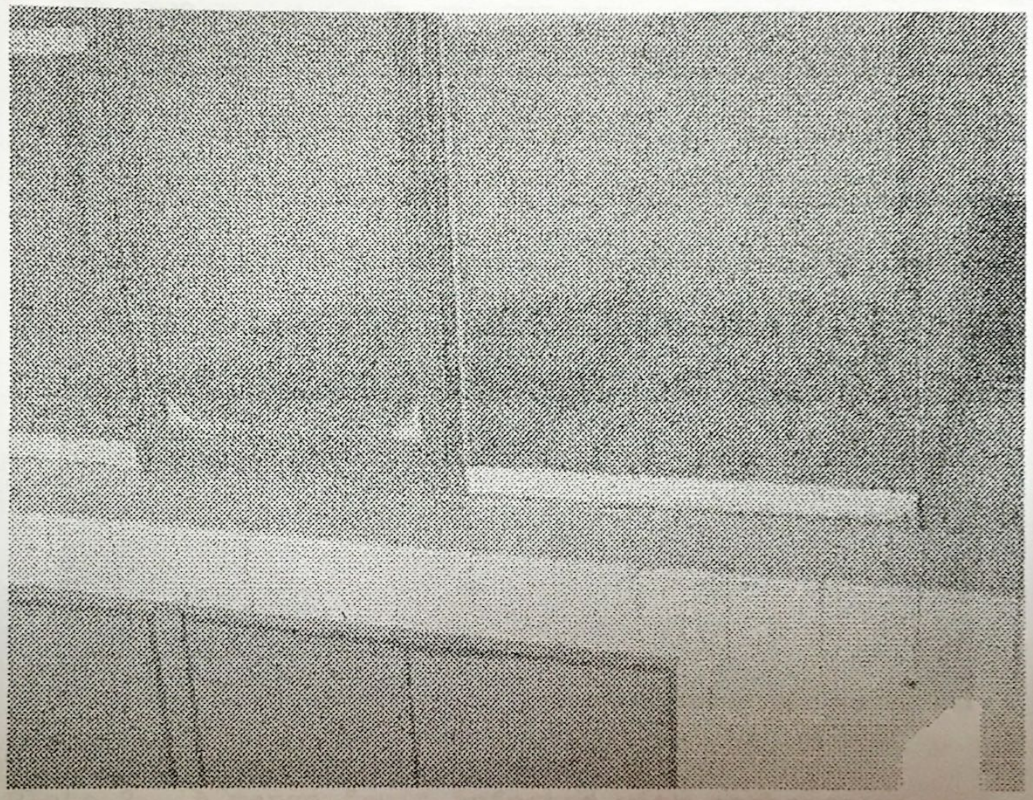

Plate 1. The cage. This was where the researchers placed the carabao mangoes after checking them everyday. This was done to protect the fruits from insects or other external materials that could damage them.

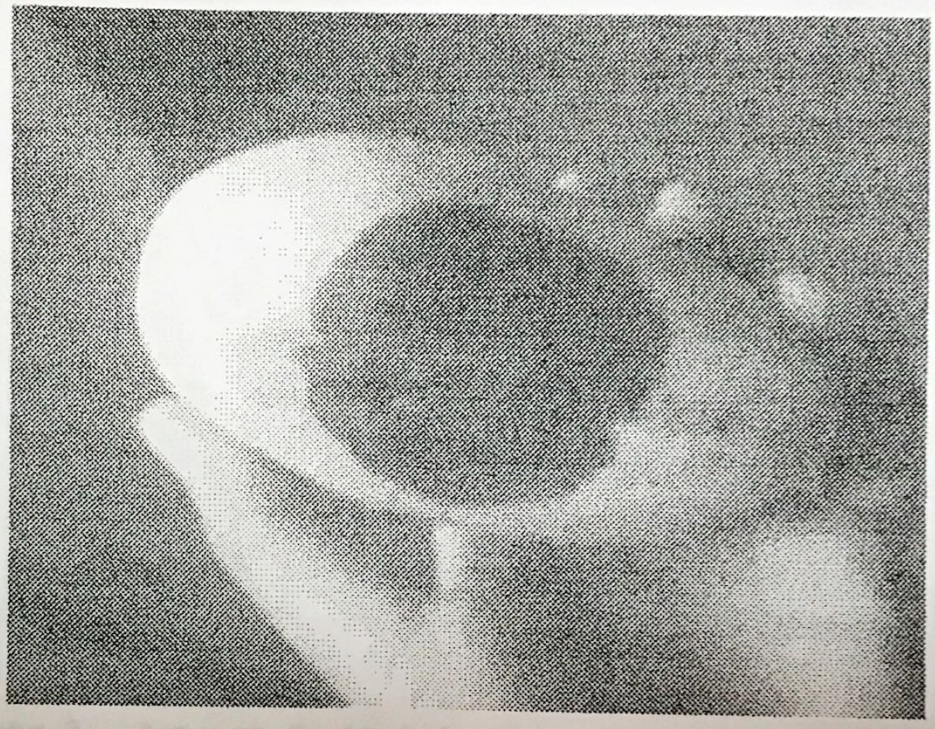

Plate 2. A mango fruit infected with anthracnose.

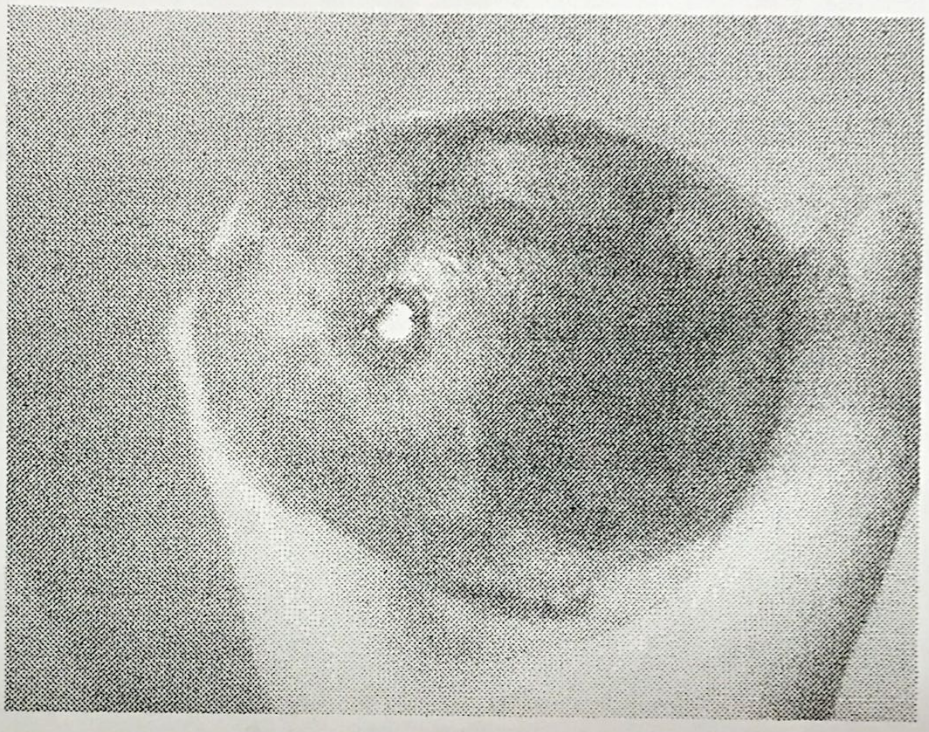

Plate 3. A mango fruit infected with diplodia stem-end-rot.

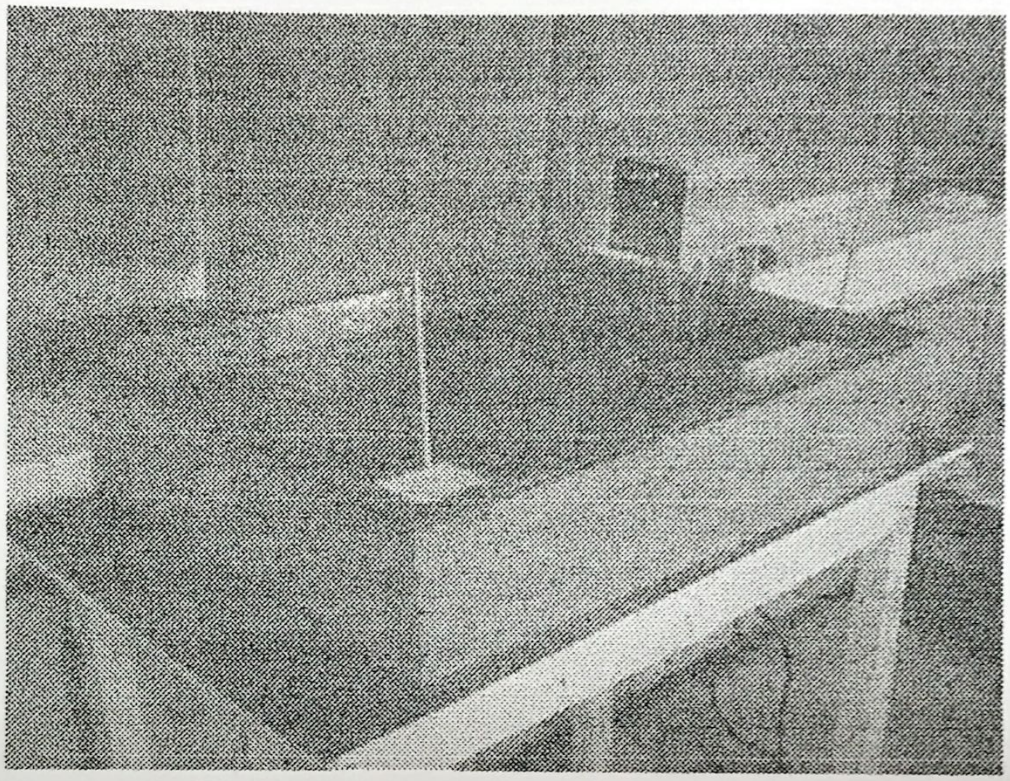

Plate 4. The hot water bath set-up. The distilled water was set to 52 degrees Celsius and the mangoes were placed in screen bags and dipped into the water for 10 - 15 minutes.

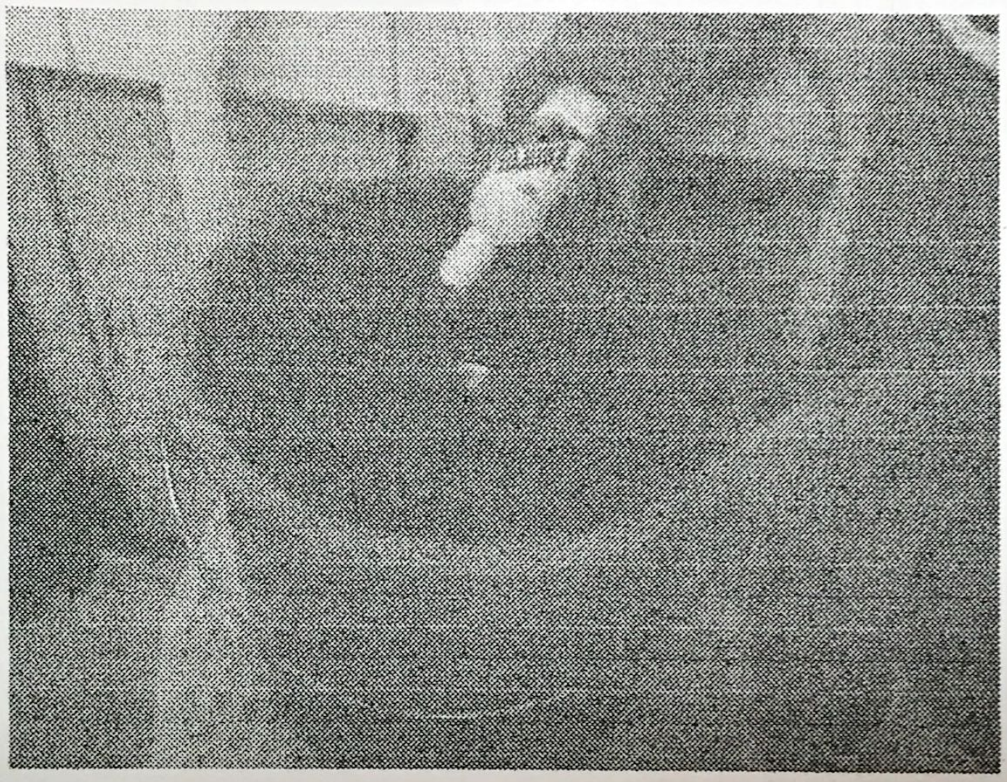

Plate 5. The zonrox dip set-up. The entire content of a bottle of zonrox was emptied into 10 liters of distilled water and the mangoes were placed in screen bags and dipped into the water for 10 - 15 minutes.

Plate 6. The caliper. This instrument was used to make precise measurements of the peel thickness and stone thickness of the dissected mango fruits.

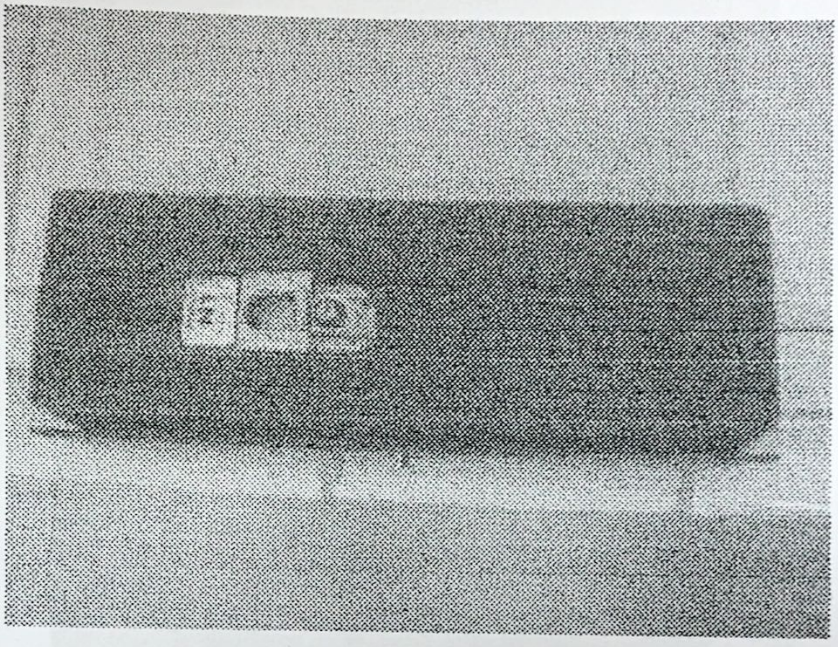

Plate 7. The refractometer. This device was used to measure the sweetness of the dissected mango fruits.

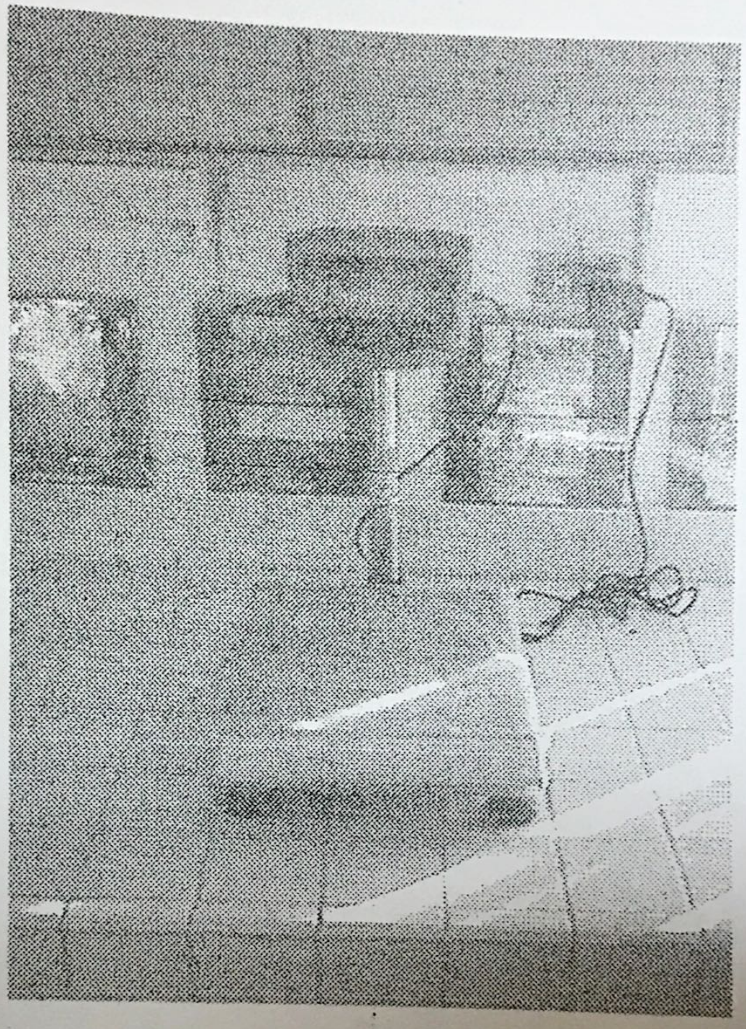

Plate 8. The digital weighing scale. This scale was used in determining the definite weights of the stone and peel of the dissected carabao mango fruits.