

**EFFECT OF AQUEOUS EXTRACTS OF PLANTAIN (*Musa paradisiaca*) AND BANANA
(*Musa sapientum*) BRACTS ON THE HEART OF FEMALE WISTAR ALBINO RATS**

BY

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CERTIFICATION

This is to certify that this project work titled “*Effect of Aqueous Extracts of Plantain (Musa paradisiaca) and Banana (Musa sapientum) Bracts on the Heart of Female Wistar Albino Rats*” was carried out by Ajiboye Oyinkansola Rofiat with Matriculation Number LSC2205399 of the Department of Biochemistry, Faculty of Life Sciences, University of Benin, Benin City, in partial fulfilment of the award of Bachelor of Sciences (B. Sc.) degree in Biochemistry.

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DEDICATION

This project is dedicated to Almighty God, whose grace, wisdom, and strength have been my constant guide throughout this academic journey. I also dedicate it to my beloved family for their endless love, encouragement, and prayers.

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I sincerely appreciate my supervisor, Prof. Agoreyo, for her invaluable guidance, patience, and support throughout the course of this research. My gratitude also goes to the Department of Biochemistry, University of Benin, for providing the facilities and academic environment that made this study possible.

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ABSTRACT

The study was designed to evaluate the histological effects of aqueous extracts of plantain (*Musa paradisiaca*) and banana (*Musa sapientum*) bracts on the heart of female Wistar rats. The bracts were extracted with distilled water. Forty-two adult female albino Wistar rats were randomly divided into seven groups (six rats per group). Group A served as the control, while groups B–D received 2.0 ml, 1.0 ml, and 0.5 ml of plantain bract extract respectively. Groups E–G received 2.0 ml, 1.0 ml, and 0.5 ml of banana bract extract respectively. The experiment was conducted for a defined period, after which the rats were sacrificed and their hearts excised for histological examination using standard procedures. The study aims to assess possible histological changes and evaluate the safety and potential biological effects of *Musa* bract extracts on cardiac tissues.

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Albino rat

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Herbal medicine, also known as phytotherapy or botanical medicine, refers to the use of plants or substances derived from plants for the prevention and management of diseases. It is an ancient practice known to humanity, dating back thousands of years across various civilisation such as those of Egypt, China and Greece. Unlike synthetic drugs, herbal medicine are prepared from whole plants or specific part of plant.

In many parts of the world, particularly Africa and Asia, herbal medicine remains an integral component of primary health care. The growing interest in natural remedies globally is attributed to their perceived safety, affordability and cultural acceptance but despite it wide usage and benefits, herbal medicines has its own challenges. Issues such as lack of standardisation, possible toxicity, and inadequate clinical evaluation have raised concerns regarding its safety and efficiency.

In recent years, there has been growing scientific interest in the therapeutic and toxicological properties of plants and their by-products. Among these, members of the genus *Musa* particularly plantain (*Musa paradisiaca*) and banana (*Musa sapientum*) have received attention for their nutritional and medicinal potentials. The bracts of these plants, which are the leaf-like structures surrounding the flower clusters, are often considered agricultural waste. However, studies have shown that they contain important bioactive compounds such as flavonoids, tannins, phenolic acids, saponins, and alkaloids, which possess antioxidant, anti-inflammatory, and cardioprotective properties.

The cardiovascular system plays a vital role in maintaining life by supplying oxygen and nutrients to body tissues and removing metabolic waste. The heart, being the central organ of this system, is highly susceptible to oxidative stress and toxic insults from both synthetic and natural compounds (Okwu and Ndu, 2020). Consequently, assessing how natural plant extracts affect cardiac structure and function is important in biomedical research.

Plants have long been a major source of bioactive compounds used in the prevention and management of diseases (Sofowora, 2018). Recently, attention has shifted toward the exploitation of underutilized plant parts such as bracts, peels, and stalks, which often contain high levels of secondary metabolites like flavonoids, alkaloids, saponins, and phenolic acids (Kumar *et al.*, 2021).

Plantain (Musa paradisiaca) and *banana (Musa sapientum)* belong to the Musaceae family and are widely cultivated in tropical regions for their fruits and industrial uses. Their bracts leaf-like structures surrounding the inflorescence are typically discarded as agricultural waste but are increasingly recognized as rich sources of natural antioxidants and phytochemicals (Radhakrishnan and Kumari, 2018).

Studies have shown that extracts from different parts of *Musa* species possess anti-inflammatory, hepatoprotective, and antioxidant properties (Okolie *et al.*, 2020). However, limited scientific evidence exists regarding their direct effects on cardiac histology, particularly in mammalian models such as Wistar rats. Since the heart is often affected by both beneficial and adverse actions of phytochemicals, it becomes necessary to evaluate the possible histological changes induced by aqueous extracts of these bracts.

1.2 Statement of the Problem

Despite the nutritional and industrial importance of *Musa* species, their bracts remain largely underutilized and are commonly discarded as waste. While the fruits and peels have been extensively studied for their pharmacological properties, little is known about the effects of the bracts, particularly on cardiac tissues. Moreover, as the use of herbal preparations continues to grow in popularity, there is a need to evaluate the safety and possible adverse effects of such plant components on vital organs, including the heart. Understanding the histological effects of plantain and banana bracts on the myocardium is essential to determine whether these plant parts possess beneficial or deleterious properties when administered in aqueous form.

1.3 Justification of the Study

The increasing rate of cardiovascular diseases and the limitations of synthetic drugs have intensified the search for natural products with cardioprotective potential. Plantain and banana bracts, being rich in phytochemicals, may exert protective effects on cardiac tissues or, conversely, induce structural alterations depending on their constituents and dosage. Evaluating their influence on the heart will contribute to the understanding of the biological significance of *Musa* bracts and their possible pharmacological applications. Additionally, since these bracts are readily available agricultural by-products, discovering beneficial effects could encourage their utilization in nutraceutical formulations or traditional medicine, reducing waste and promoting environmental sustainability.

1.4 Aim of the Study

The aim of this study is to evaluate the effect of aqueous extracts of plantain (*Musa paradisiaca*) and banana (*Musa sapientum*) bracts on the heart of female Wistar rats.

1.5 Specific Objectives

The specific objectives of this study are to:

- Prepare aqueous extracts of plantain and banana bracts.
- Administer varying doses of the extracts to female Wistar rats.
- Examine the histological architecture of the heart following extract administration.
- Compare the histological effects of plantain bract extract and banana bract extract on cardiac tissues.

1.6 Significance of the Study

This study contributes to scientific understanding of the potential cardiac impact of *Musa* bract extracts. Researches may help guide safe usage levels of these by-products and support their development as natural antioxidant sources (Chakraborty *et al.*, 2019). It also provides baseline histological data for future biochemical and toxicological evaluations.

1.7 Scope of the Study

The study focuses on the histological evaluation of the heart of female Wistar rats administered with different doses of aqueous extracts of *Musa paradisiaca* and *Musa sapientum* bracts.

1.8 Limitations

The study was limited by the availability of electricity , cost of animal care.

CHAPTER TWO

LITERATURE REVIEW

2.1 The Heart and Its Function

The heart is a muscular organ that pumps blood through the circulatory system by rhythmic contraction and relaxation. Structurally, it is composed of specialized cardiac muscle cells known as cardiomyocytes, which possess striations and intercalated discs allowing for synchronized contraction. The myocardium, which forms the bulk of the heart wall, relies heavily on aerobic metabolism and is highly sensitive to oxidative damage.

2.2 Cardiac Histology

The heart wall consists of three main layers: the **epicardium**, **myocardium**, and **endocardium**. The myocardium contains the contractile elements responsible for pumping blood. Any alteration in the structure or arrangement of cardiac fibers can impair function. Histological studies of cardiac tissues often serve as sensitive indicators of toxic or therapeutic responses to bioactive substances.

The myocardium—comprising specialized striated muscle fibers—is most affected by toxic substances and oxidative stress (Sharma and Gupta, 2021).

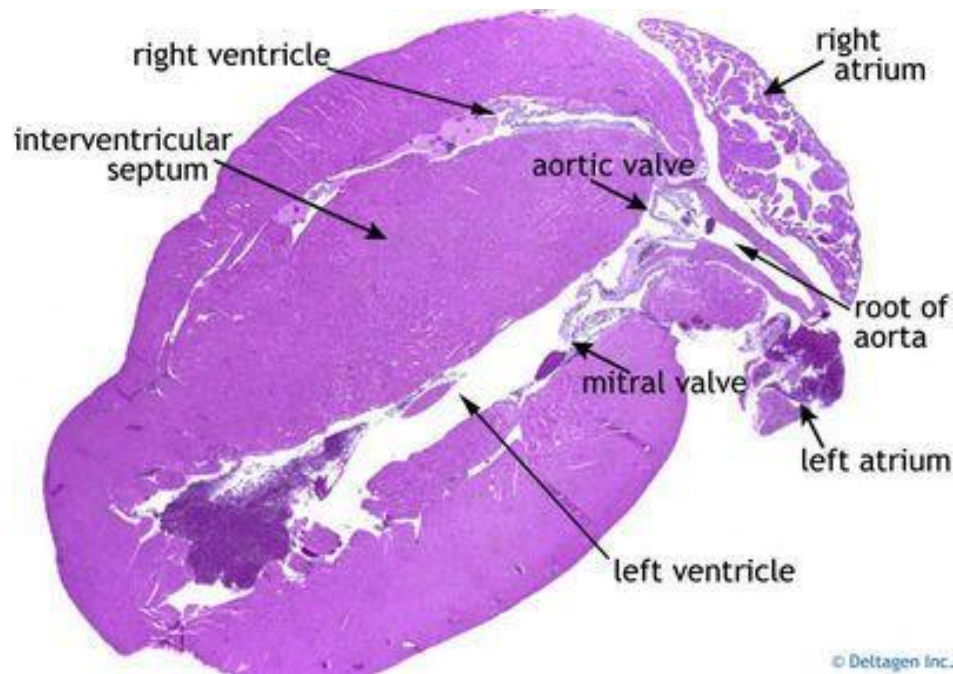


Figure 2.1: Heart Histology

2.3 The Genus *Musa*

The genus *Musa* belongs to the family Musaceae and includes both plantains and bananas. They are widely cultivated in tropical and subtropical regions for their fruits. Beyond the fruit, other plant parts such as peels, leaves, pseudostems, and bracts have shown potential pharmacological activities.

2.4 Phytochemical Composition of *Musa* Bracts

Research has identified several bioactive compounds in *Musa* bracts, including:

- **Flavonoids:** Powerful antioxidants that scavenge free radicals.
- **Tannins:** Possess astringent and anti-inflammatory properties.
- **Saponins:** May lower cholesterol and improve heart function.

- **Phenolic compounds:** Exhibit cardioprotective and antimicrobial effects. These constituents contribute to the medicinal potential of *Musa* bracts and justify their scientific evaluation.

2.5 Medicinal and Nutritional Uses of Musa Species

Various parts of *Musa* plants have been used in traditional medicine for treating ailments such as ulcers, hypertension, diarrhea, and infections. The antioxidant and anti-inflammatory potential of *Musa* extracts has also been reported to contribute to cardiovascular health

2.6 Plant Extracts and Cardioprotection

Numerous plant-based antioxidants have been shown to mitigate oxidative stress in cardiac tissues, thereby preventing or minimizing myocardial damage. The protective mechanisms involve scavenging of reactive oxygen species (ROS), inhibition of lipid peroxidation, and enhancement of endogenous antioxidant enzymes.

2.7 Experimental Use of Wistar Rats

Wistar rats are a preferred animal model in biomedical research due to their genetic stability, ease of handling, and well-characterized physiology. Female rats, in particular, are often used in toxicological studies to evaluate the impact of compounds on various organs, including the heart.

2.8 The Heart of a Wistar Rat

2.8.1 Introduction

The heart of a Wistar rat is a **vital muscular organ** responsible for maintaining the continuous flow of blood throughout the body. It ensures the transport of oxygen, nutrients, hormones, and metabolic wastes, thereby supporting cellular metabolism and homeostasis. Due to the close

physiological resemblance between rat and human cardiovascular systems, **Wistar rats serve as reliable experimental models** in biomedical research, particularly in studies involving cardiovascular diseases, pharmacology, and toxicology.

2.8.2 Anatomical Structure

The heart of the Wistar rat possesses **four distinct chambers**, namely the **right and left atria**, and the **right and left ventricles**, which function in a coordinated manner to maintain blood circulation.

- The **right atrium** collects deoxygenated blood from the systemic circulation through the **superior and inferior vena cava**, transferring it to the **right ventricle**.
- The **right ventricle** then pumps this blood to the **lungs** via the **pulmonary artery** for oxygenation.
- Oxygenated blood returns to the **left atrium** through the **pulmonary veins** and is subsequently passed to the **left ventricle**.
- The **left ventricle**, being the most muscular chamber, pumps blood into the **aorta**, distributing it throughout the body.

2.8.3 Histological Organization

The wall of the Wistar rat heart is made up of **three principal layers**:

- **Epicardium:** The outermost layer composed of connective tissue and a layer of mesothelial cells.
- **Myocardium:** The thick, muscular middle layer consisting of **cardiac muscle fibers** (cardiomyocytes) responsible for the contractile activity of the heart.

- **Endocardium:** The innermost layer lined by **endothelial cells**, providing a smooth surface for blood flow.

The **left ventricular myocardium** is notably thicker than the right due to the greater force required to propel blood through the systemic circulation. The **cardiac muscle cells** are branched and interconnected by **intercalated discs**, which facilitate synchronized contraction and efficient impulse transmission.

2.8.4 Physiological Function

The rat heart is **myogenic**, meaning it can initiate its own electrical impulses without external neural stimulation. The **sinoatrial (SA) node** acts as the natural pacemaker, generating rhythmic impulses that travel through the **atrioventricular (AV) node**, **bundle of His**, and **Purkinje fibers**, resulting in coordinated atrial and ventricular contractions.

The **average heart rate** in a healthy adult Wistar rat ranges between **300 and 400 beats per minute**, which is significantly faster than in humans. Cardiac performance is influenced by various factors such as temperature, stress, hormonal activity, and experimental conditions.

2.8.5 Blood Supply

The heart receives oxygenated blood through the **right and left coronary arteries**, which branch from the base of the aorta. Venous drainage occurs through the **coronary veins**, which empty into the **coronary sinus** before returning to the right atrium. This extensive coronary circulation is essential for meeting the high metabolic demand of the cardiac muscle tissue.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Materials

- Fresh bracts of plantain (*Musa paradisiaca*) and banana (*Musa sapientum*)
- Distilled water
- Wistar rats (female, adult)
- Standard laboratory reagents and equipment
- Microscope and histological staining reagents

3.2 Collection and Preparation of Plant Materials

Fresh bracts of *Musa paradisiaca* and *Musa sapientum* were obtained from plantain and banana tree within the school premises. They were washed and pounded . The aqueous extracts were prepared by soaking a known quantity of the pounded bract in distilled water, followed by filtration and storage into containers.



Figure 3.1a: Banana bracts frontal view



Figure 3.1b: Banana bracts dorsal view



Figure 3.2a: Plantain bracts frontal view



Figure 3.2b: Plantain bracts dorsal view

3.3 Experimental Animals

Forty-two (42) adult female albino Wistar rats weighing between 95–110 g were procured and acclimatized under standard laboratory conditions for one week before commencement of the experiment. They were fed properly and provided water.

3.4 Administration of Extracts

Extracts were administered orally once daily for a specified experimental duration. The control group which comprised of six albino female wistar rats received distilled water and feed only.

The subsequent groups were divided into 2 groups which contained 3 cages (B, C, D)that were fed different doses of banana bract extract and another 3 cages (E,F,G) that were fed different doses of plantain bracts extract. Each cages contain 6 female albino wistar rat respectively.

Group	Treatment	Dosage
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A Control	Received distilled water and feed	
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B	Banana bract extract	0.5 ml
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C	Banana bract extract	1.5 ml
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D	Banana bract extract	2.0 ml
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E	Plantain bract extract	0.5 ml
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F	Plantain bract extract	1.5 ml
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G	Plantain bract extract	2.0ml
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3.5 Histological Analysis

At the end of the experiment, the rats were sacrificed, and their hearts were excised and fixed in 10% formalin. Tissues were processed, sectioned, and stained using Hematoxylin and Eosin (H&E) for microscopic examination of cardiac architecture.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Histology of Heart Result

4.1.1 Measurement of The Body Weight

The table below shows the average weight in grams of female Wistar rats measured prior to feed administration, as well as the average weight in grams after .

Table 4.1: Effect of Aqueous Plantain Bracts Extract on the Body Weight of Female Wistar Albino rat

Test groups	Mean Initial Body Weight (g)	Mean Final Body Weight (g)	Change in Body Weight (g)
Control	99.4±2.25	136.2±10.54	36.8±11.19
2ml	95.6±5.12	153.2±10.87	57.6±15.58
1ml	107.2±4.33	133.6±13.51	32.4±11.77
0.5ml	104±5.99	152.8±9.44	48.8±8.35

Table 4.2: Effect of Aqueous Banana Bracts Extract on the Body Weight of Female Wistar Albino rat

Test groups	Mean Initial Body Weight(g)	Mean Final Body Weight(g)	Change in Body Weight (g)
Control	99.4±2.25	136.2±10.54	36.8±11.19
2ml	110.2±3.44	157.4±8.86	47.2±9.11
1ml	107.8±2.73	134±9.81	29±6.66
0.5ml	107.2±4.92	146±2.92	38.8±6.48

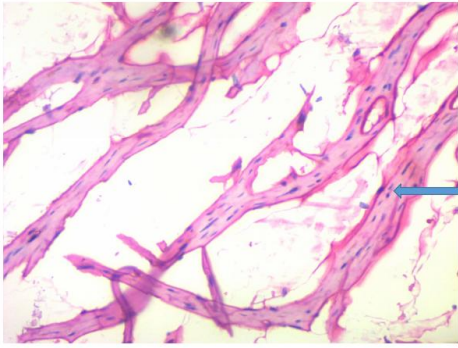


Figure 4.1 Photomicrograph of the heart of female control rat (x400).

Section of cardiac muscle shows myocytes (arrow) with peripherally placed nuclei surrounded by eosinophilic cytoplasm. Features are in keeping with NORMAL MYOCYTES

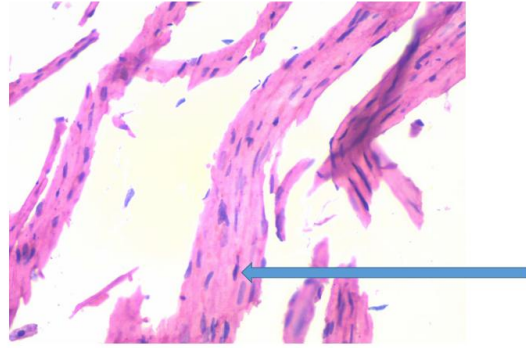


Figure 4.2 Photomicrograph of the heart of female rat administered 2ml plantain bract Extract (x400)

Section of cardiac muscle shows mild histological changes, slight disruption of cardiac muscles.

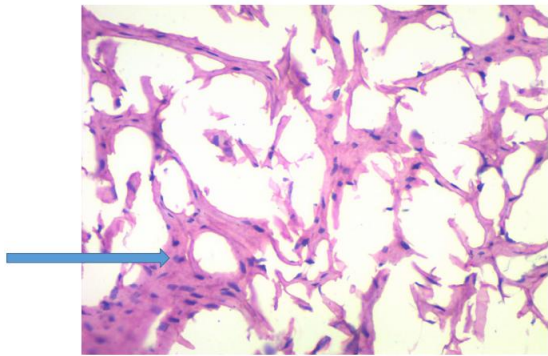


Figure 4.3 Photomicrograph of the heart of female rat administered 1ml plantain bract Extract (x400)

Section of cardiac muscle shows myocytes (arrow) with peripherally placed nuclei surrounded by eosinophilic cytoplasm. Features are in keeping with NORMAL MYOCYTES

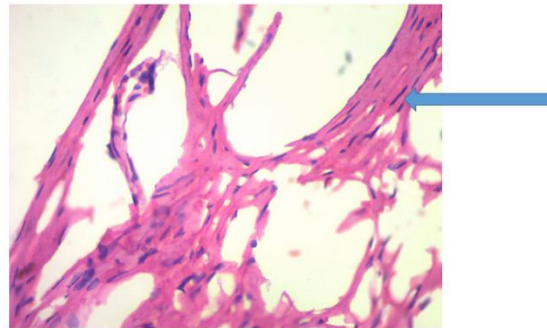


Figure 4.4 Photomicrograph of the heart of female rat administered 0.5ml plantain bract Extract (x400)

Section of cardiac muscle shows myocytes (arrow) with peripherally placed nuclei surrounded by eosinophilic cytoplasm. Features are in keeping with NORMAL MYOCYTES

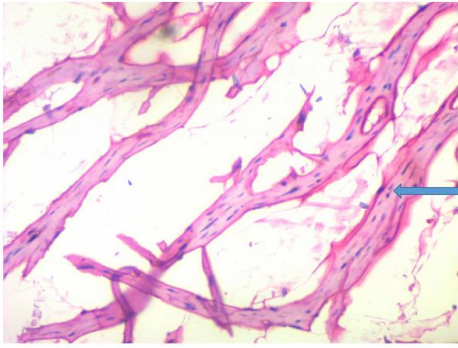


Figure 4.5 Photomicrograph of the heart of female control rat (x400).

Section of cardiac muscle shows myocytes (arrow) with peripherally placed nuclei surrounded by eosinophilic cytoplasm.

Features are in keeping with NORMAL MYOCYTES

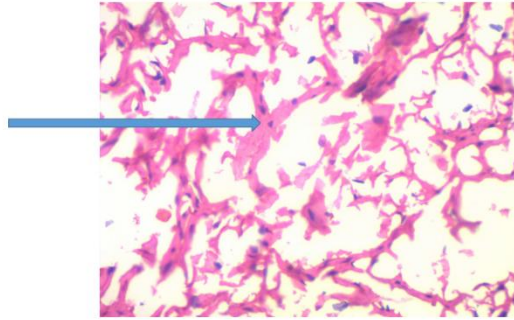


Figure 4.6 Photomicrograph of the heart of female rat administered 2ml banana bract Extract (x400)

Section of cardiac muscle shows mild histological changes, slight disruption of cardiac muscles.

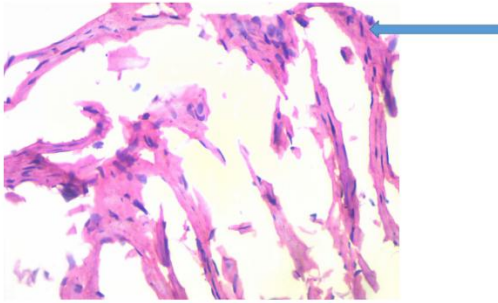


Figure 4.7: Photomicrograph of the heart of female rat administered 1ml banana bract Extract (x400)

Section of cardiac muscle shows myocytes (arrow) with peripherally placed nuclei surrounded by eosinophilic cytoplasm. Features are in keeping with NORMAL MYOCYTES

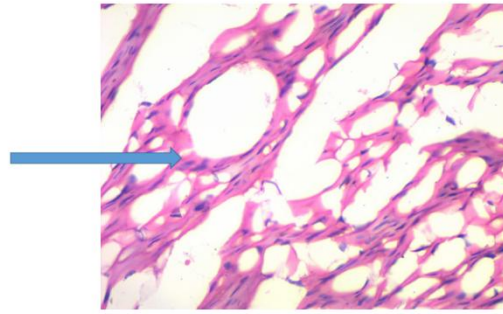


Figure 4.8 Photomicrograph of the heart of female rat administered 0.5ml banana bract Extract (x400)

Section of cardiac muscle shows myocytes (arrow) with peripherally placed nuclei surrounded by eosinophilic cytoplasm. Features are in keeping with NORMAL MYOCYTES

5.1 Results Overview

The administration of aqueous extracts of *Musa paradisiaca* (plantain) and *Musa sapientum* (banana) bracts to female Wistar rats produced observable histological changes in cardiac tissues, particularly at higher doses. The control group exhibited normal cardiac histoarchitecture characterized by well-arranged cardiac muscle fibers with intact nuclei and intercalated discs.

Groups that received low and moderate doses of both extracts (0.5 ml and 1.5 ml) displayed normal cardiac structures comparable to the control, indicating no significant histopathological alterations. However, at higher doses (2.0 ml), mild histological changes such as interstitial edema, focal necrosis, and slight disruption of cardiac muscle fibers were observed. These findings suggest that while low doses of *Musa* bract extracts are relatively safe, higher concentrations may produce mild cardiac stress or toxicity.

5.2 Discussion

The findings of this study indicate that aqueous extracts of plantain and banana bracts exert **dose-dependent effects** on the myocardium of female Wistar rats. The absence of significant alterations at low and moderate doses supports the potential safety and possible cardioprotective effects of these extracts, which may be attributed to their phytochemical constituents such as flavonoids and phenolic compounds.

At higher doses, the observed mild tissue degeneration could be linked to oxidative imbalance caused by excessive bioactive compounds or metabolites. Similar findings have been reported by Akinmoladun *et al.* (2021), who noted that excessive intake of plant extracts with strong antioxidant activity may paradoxically induce oxidative stress when consumed in large quantities.

The antioxidant properties of *Musa* bracts reported in previous studies (Chakraborty *et al.*, 2019; Okolie *et al.*, 2020) may contribute to the preservation of myocardial integrity at lower doses. These compounds scavenge reactive oxygen species, stabilize cell membranes, and prevent lipid peroxidation. However, high-dose exposure may exceed the body's metabolic capacity to handle phytochemicals, leading to mild toxicity.

The differences observed between plantain and banana bract extracts were minimal, suggesting that both share similar phytochemical profiles with comparable biological effects. Nonetheless, plantain bract extract appeared slightly more potent in eliciting histological changes at higher doses, possibly due to variations in flavonoid concentration or extraction yield.

Overall, the results reinforce the need for **dose optimization** and **phytochemical standardization** before the inclusion of *Musa* bract extracts in pharmacological formulations or dietary supplements.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

This study evaluated the histological effects of aqueous extracts of plantain (*Musa paradisiaca*) and banana (*Musa sapientum*) bracts on the heart of female Wistar rats. The results demonstrated that low and moderate doses of both extracts did not cause significant histological alterations in cardiac tissues, whereas higher doses produced mild to moderate structural changes such as interstitial edema, focal necrosis, and slight myocardial fiber disruption.

These findings suggest that the aqueous extracts of *Musa* bracts are relatively safe at low concentrations and may possess cardioprotective potential due to their antioxidant constituents. However, at higher doses, some components may exert mild toxic or degenerative effects on cardiac tissues.

Therefore, the study concludes that the **effects of plantain and banana bract extracts on the heart are dose-dependent**—beneficial at low concentrations but potentially adverse at higher levels.

6.2 Recommendations

- **Phytochemical Standardization:** Quantify the phytochemical constituents of *Musa* bracts to identify compounds responsible for the observed effects.
- **Biochemical Correlation:** Evaluate serum biomarkers such as CK-MB, LDH, and troponin to correlate histological findings.
- **Dose Optimization:** Conduct long-term studies to determine safe dosage ranges.

- **Comparative Solvent Studies:** Use different solvents (ethanol, methanol, water) to assess extraction efficiency.
- **Human Application:** Perform further studies before extrapolating to humans.
- **Utilization of Agricultural By-products:** Promote the use of *Musa* bracts in nutraceutical or pharmaceutical industries to reduce waste and enhance sustainability.

6.3 Contribution to Knowledge

- Provides novel histological evidence of *Musa* bract effects on cardiac tissues.
- Demonstrates dose-dependent myocardial effects of aqueous *Musa* extracts.
- Highlights potential use of *Musa* bracts as antioxidant sources in natural therapeutics.

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