

**THE EFFECT OF AQUEOUS EXTRACT OF *Sphenocentrum jollyanum* ON KIDNEY  
FUNCTION**



**BY**

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BENIN CITY**

**NOVEMBER, 2025.**

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**AN UNDERGRADUATE PROJECT WORK SUBMITTED TO THE DEPARTMENT OF  
SCIENCE LABORATORY TECHNOLOGY, FACULTY OF LIFE SCIENCES,  
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SCIENCE (B.SC.) DEGREE IN SCIENCE LABORATORY TECHNOLOGY**

**NOVEMBER, 2025.**

## CERTIFICATION

This is to certify that this research titled “**THE EFFECT OF AQUEOUS EXTRACT OF *Sphenocentrum jollyanum* ON KIDNEY FUNCTION**” was carried out by “**Isiuwa Precious HARRISON (Miss)**” with matriculation number “**LSC2003193**” and presented to the Department of Science Laboratory Technology, Faculty of Life Sciences, University of Benin, Benin City; in partial fulfillment of the requirements for the award of Bachelor of Science (B.Sc.) in Science Laboratory Technology. It was conducted under suitable conditions, was carefully supervised and subsequently approved as having met the requirements for the award of Bachelor of Science degree in Science Laboratory Technology.

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## DECLARATION

I “Isiuwa HARRISON (Miss)” declares that “THE EFFECT OF AQUEOUS EXTRACT OF *Sphenocentrum jollyanum* ON KIDNEY FUNCTION” is my own work and that all sources that I have used or quoted have been acknowledged by means of complete references and that this work has not been submitted before for any other degree at any other University.

.....

.....

Isiuwa HARRISON (Miss)

DATE

## **DEDICATION**

This project work is dedicated to the Almighty God for his grace and mercies and to my family for their support and love throughout my period of study.

## **ACKNOWLEDGEMENT**

My greatest gratitude goes to God Almighty for his infinite mercy and Grace upon my life, the life of my family and friends and for the success of this work and His guidance. I sincerely appreciate my supervisor Mr James OSEYOMON for his guidance, tolerance and supervisory role throughout the course of this work. I am grateful to my parents MR and MRS HARRISON for their support and prayers throughout the process of this project. Also to my siblings, I value your support and prayers. Lastly, I wish to extend my gratitude to my friends and colleagues in the department of science laboratory technology, for their encouragements and supports, I pray all your labors be rewarded.

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## ABSTRACT

*Sphenocentrum jollyanum* is an important West African medicinal plant traditionally used for treating fever, digestive disorders, and metabolic ailments. Despite its widespread use, limited information exists regarding its biochemical safety and systemic effects during prolonged exposure. This study investigated the effect of aqueous leaf extract of *Sphenocentrum jollyanum* on renal and hepatic biochemical parameters in Wistar rats following 28 days of sub-chronic oral administration. Twenty male Wistar rats were divided into four groups of five animals each: a control group that received distilled water and three experimental groups treated with 200 mg/kg, 400 mg/kg, and 800 mg/kg of the aqueous leaf extract, respectively, for 28 consecutive days. Blood samples were analyzed for creatinine, urea, uric acid, and aspartate aminotransferase (AST) using standard spectrophotometric methods. The mean biochemical values obtained were as follows: creatinine ( $4.25 \pm 2.07$ – $8.96 \pm 3.32$  mg/dL), urea ( $99.82 \pm 7.00$ – $161.54 \pm 22.92$  mg/dL), uric acid ( $8.18 \pm 3.75$ – $13.57 \pm 3.88$  mg/dL), and AST ( $54.41 \pm 7.28$ – $74.03 \pm 18.06$  U/L). The results showed no statistically significant differences ( $p > 0.05$ ) between treated and control groups across all parameters. A slight, non-dose-dependent variation in creatinine and a mild reduction in urea and AST levels at higher doses indicated stable renal and hepatic function. These findings suggest that the extract does not induce nephrotoxicity or hepatotoxicity but may support metabolic and antioxidant balance. In conclusion, sub-chronic administration of *S. jollyanum* aqueous extract in Wistar rats was well tolerated and biochemically safe at all tested doses. The study validates the plant's traditional use as a detoxifying and restorative agent and supports its potential as a natural source of hepatoprotective and nephroprotective compounds.

## CHAPTER ONE

### INTRODUCTION

#### 1.1 BACKGROUND OF THE STUDY

Medicinal plants have continued to occupy a critical place in health care delivery across many parts of the world, especially in resource-limited settings where conventional medical services may be costly, inaccessible or inadequate. In many developing countries, traditional botanical therapies remain a cornerstone of local primary care, relying on ancestral knowledge and the therapeutic potential of indigenous flora rather than solely on synthetic pharmaceuticals (Olorunnisola *et al.*, 2017; Oboh *et al.*, 2024). Within West Africa, the longstanding ethnobotanical tradition and cultural reliance on medicinal plants have spurred increasing scientific interest in investigating native species for their phytochemical profile, biological activities and therapeutic promise (Adeleke *et al.*, 2024).

One plant of growing scientific and ethnomedicinal significance is *Sphenocentrum jollyanum* Pierre (Menispermaceae), a shrub indigenous to the moist rainforest zones of West Africa, including Nigeria, Ghana, Côte d'Ivoire and Cameroon (Akinwumi and Sonibare, 2022). Locally known under vernacular names such as “Aduro kokoo” among Ghanaian communities, the plant is widely harvested from wild under-storey habitats and considered a valuable remedy by traditional healers (Olorunnisola *et al.*, 2017). It generally thrives in shaded gallery or secondary forest ecosystems, where it grows beneath the canopy in humid lowland regions (Akinwumi and Sonibare, 2022).

In traditional health practice, multiple morphological parts of *S. jollyanum* roots, stem bark, leaves and fruits are used in remedy formulations. In southern Nigeria and Ghana, for instance, extracts of the root are traditionally administered to relieve constipation, improve appetite and

support digestive processes (Olorunnisola *et al.*, 2017). The stem bark and roots are sometimes used as general tonics or aphrodisiacs, while the fruits are incorporated into mixtures for cough relief or to combat weakness or fatigue (Adeleke *et al.*, 2024). These extensive uses underscore the plant's dual importance: culturally as a traditional remedy, and pharmaceutically as a candidate for bioactive compound investigation.

Phytochemical investigations of *S. jollyanum* have revealed it to be rich in diverse secondary metabolites. Screening studies have identified alkaloids, flavonoids, saponins, tannins and terpenoids (Uka *et al.*, 2020; Akinwumi and Sonibare, 2022). More detailed analyses have isolated compounds such as isoquinoline alkaloids (columbin, isocolumbin) and phytoecdysteroids (pinnatasterone, polypodine B) which may underpin some of the plant's bioactivities (Akinwumi and Sonibare, 2022). Modern pharmacological research has further demonstrated that extracts of *S. jollyanum* possess antidiabetic, antioxidant, hepatoprotective, antimalarial and anti-inflammatory activities (Adeleke *et al.*, 2024; Oboh *et al.*, 2024; Ugwu *et al.*, 2023).

Despite these encouraging findings, there remain significant gaps in knowledge. A majority of the published literature has focused on general ethnomedicinal surveys or initial in-vitro and in-vivo models (Uka *et al.*, 2020; Oboh *et al.*, 2024). Much less is known about its detailed mechanisms of action, organ-specific toxicity or pharmacokinetics, standardisation of extract preparations, or clinical-level safety and efficacy. Importantly, its effects on liver biochemical function critical given the liver's role in metabolism, detoxification, storage and homeostasis have been insufficiently explored. Considering the traditional use of the plant as a tonic and metabolic remedy, analysis of how *S. jollyanum* influences hepatic enzyme levels, protein synthesis, oxidative stress markers, and lipid metabolism is crucial.

## **1.2 AIM OF STUDY**

The aims of the study was to evaluate the effect of aqueous extract of *Sphenocentrum jollyanum* on kidney function following 28 days of daily oral administration in experimental animal models (wistar rats/mice)

## **1.3 OBJECTIVES OF STUDY**

The specific objectives of this study are to:

- determine the effect of aqueous leaf extract of *Sphenocentrum jollyanum* on serum total Aspartate Aminotransferase (AST) levels in rats;
- assess the effect of the extract on Creatinine concentration;
- evaluate the changes in Uric acid and Urea levels following extract administration; and
- assess the potential of the aqueous leaf extract to serve as a natural kidney-regulating agent.

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 GENERAL OVERVIEW

Medicinal plants have long been recognized as a vital component of global health systems, particularly in developing regions where access to modern pharmaceuticals is often limited. They have served as the cornerstone of human healthcare for millennia, forming the basis of traditional medical practices and serving as templates for the discovery and synthesis of numerous modern drugs (Sofowora, 2018; Farnsworth, 2021). Throughout history, natural products derived from plants have contributed significantly to the development of pharmacologically active agents such as quinine, morphine, artemisinin and aspirin compounds that originated from traditional medicinal knowledge (Balunas and Kinghorn, 2021).

In many developing nations, especially in Africa, Asia and parts of Latin America, a large proportion of the population continues to depend on medicinal plants for their primary healthcare needs. This reliance is largely due to their accessibility, affordability, cultural acceptability and the perceived safety of herbal preparations compared to synthetic drugs (Olorunnisola *et al.*, 2017; Oboh *et al.*, 2024). The World Health Organization (WHO, 2022) estimates that nearly 80% of people in developing countries still utilize herbal remedies for healthcare purposes. This enduring trust in plant-based medicine underscores its relevance not only as an aspect of traditional health systems but also as a foundation for scientific exploration and drug discovery.

Over the past few decades, there has been a renewed global interest in phytomedicine, driven by the need to identify new bioactive compounds that can offer therapeutic benefits with fewer

adverse effects than synthetic pharmaceuticals (Adeleke *et al.*, 2024; Yusuf *et al.*, 2023). Advances in analytical chemistry, molecular biology and pharmacology have enabled researchers to isolate, characterize and evaluate numerous plant-derived compounds with potential pharmacological activity. These studies have revealed that many medicinal plants contain a vast array of secondary metabolites such as alkaloids, flavonoids, saponins, tannins, terpenoids and phenolic compounds that exert diverse biological effects including antioxidant, antimicrobial, anti-inflammatory, antidiabetic and hepatoprotective properties (Trease and Evans, 2020; Pandey *et al.*, 2023)

## **2.2 TAXONOMY AND BOTANICAL CLASSIFICATION**

The taxonomic classification of *Sphenocentrum jollyanum* is as follows:

Kingdom: Plantae

Division: Magnoliophyta (Angiosperms)

Class: Magnoliopsida (Dicotyledons)

Order: Ranunculales

Family: Menispermaceae

Genus: *Sphenocentrum*

Species: *Sphenocentrum jollyanum* Pierre

The Menispermaceae family is composed primarily of climbing shrubs and woody plants distributed throughout tropical and subtropical regions. Many members of this family are rich in pharmacologically active alkaloids, including morphinan and aporphine derivatives (OICC Press, 2022; Akomolafe *et al.*, 2019). *S. jollyanum* differs slightly from other members of the family, being a non-climbing erect shrub recognized by its yellowish-brown stem and fleshy red fruits (Adeleke *et al.*, 2024).



Plate 1: *Sphenocentrum jollyanum* Pierre

**Photocredit:** (Harrison Precious, 2025).

## 2.3 BOTANICAL DESCRIPTION

*Sphenocentrum jollyanum* Pierre is a perennial, woody shrub of moderate height, typically reaching between 1 and 2 meters when mature. The plant exhibits a firm, fibrous, and slightly ridged stem with distinct nodes and internodes that contribute to its erect growth form. When freshly cut or chewed, the stem exudes a yellowish-brown sap characterized by an intensely bitter taste an attribute linked to the high concentration of isoquinoline alkaloids and other secondary metabolites present within its tissues (Uka *et al.*, 2020; Adusei *et al.*, 2023; Adeleke *et al.*, 2024).

The leaves are simple, alternate, and glabrous, showing an elliptical to obovate shape, with an average length of 10–15 cm and width of 4–8 cm. The leaf apex is acute, the base cuneate, and the margins entire, with a clearly defined pinnate venation pattern visible on the abaxial (lower) surface. The leaf blade is thin but leathery, with a bright green adaxial surface and a lighter underside. The petiole is slender, cylindrical, and approximately 1–2 cm long (Agyare *et al.*, 2023). These morphological features are essential for the plant's efficient photosynthetic activity and are consistent with its adaptation to humid, shaded forest environments.

The plant produces small, yellowish-green unisexual flowers that are usually arranged in axillary or terminal panicles. Each flower consists of three to four sepals and petals, with staminate (male) and pistillate (female) flowers occurring on separate individuals, indicating a dioecious reproductive system (Farnsworth, 2021; Agyare *et al.*, 2023). Pollination is mainly entomophilous facilitated by small forest insects that are attracted by the faint fragrance and nectar of the flowers.

The fruit is a small, fleshy drupe measuring about 1 cm in diameter. When unripe, it appears

green, gradually turning orange or bright red upon ripening. The pericarp encloses a single ovoid seed with a hard endocarp and fibrous mesocarp. The seed, like other plant parts, is bitter and aromatic, reflecting its high alkaloid concentration (Olorunnisola *et al.*, 2017). Microscopic examination of the stem and root sections reveals the presence of numerous secretory canals and oil globules, which are common anatomical features among members of the Menispermaceae family (Trease and Evans, 2020).

Vegetative propagation in *S. jollyanum* is achieved through stem cuttings or root suckers, although natural regeneration occurs by seed dispersal mediated by birds and small mammals that feed on the fruit pulp (Yusuf *et al.*, 2023). The plant grows best in partially shaded areas, requiring moderate sunlight for optimal vegetative and reproductive development. Its morphological resilience and adaptability to forest-floor microclimates contribute to its persistence in the wild.

The entire plant is a repository of pharmacologically active compounds, distributed in varying concentrations across the roots, stem bark, leaves, and fruits. The roots and stems are particularly rich in alkaloids, diterpenes, and glycosides, while the leaves contain higher levels of flavonoids and phenolic compounds (Uka *et al.*, 2020; Oboh *et al.*, 2024). This biochemical diversity not only supports the plant's medicinal value but also underpins its ecological adaptability in the dynamic tropical rainforest ecosystem.

## 2.4 GEOGRAPHICAL DISTRIBUTION

*Sphenocentrum jollyanum* is native to the humid tropical rainforests of West and Central Africa. It thrives predominantly in lowland forest zones characterized by dense vegetation, high humidity, and consistent rainfall. The species is widely distributed in countries such as Nigeria, Ghana, Cameroon, Côte d'Ivoire, Liberia, Sierra Leone, and the Democratic Republic of Congo (Uka *et al.*, 2020; OICC Press, 2022). Within these regions, it occurs naturally under shaded forest canopies, along riverbanks, and in secondary forest undergrowth where moisture levels are high and sunlight is filtered through dense vegetation.

The plant flourishes in loamy, well-drained soils rich in organic matter and prefers pH ranges between 5.5 and 7.0. It performs optimally in environments with annual rainfall exceeding 2000 mm and average temperature ranges between 25 °C and 32 °C (Olorunnisola *et al.*, 2017). In Nigeria, *S. jollyanum* is prevalent in the southern and southwestern forest belts, particularly in states such as Cross River, Akwa Ibom, Oyo, Ondo, and Edo, where it forms part of the undergrowth vegetation of tropical rainforests (Oboh *et al.*, 2024).

Ecologically, the species contributes to the structural diversity of the forest ecosystem, providing food and shelter for certain insects and small mammals. Its fruits are occasionally consumed by birds, aiding in seed dispersal and natural regeneration. Despite its adaptability, *S. jollyanum* faces increasing anthropogenic pressures such as deforestation, agricultural expansion, and overharvesting for medicinal and commercial purposes (Adeleke *et al.*, 2024). The unsustainable collection of roots and stems for traditional medicine has led to localized depletion in several regions of Nigeria and Ghana (Yusuf *et al.*, 2023).

As a result, researchers and conservationists have advocated for *ex situ* propagation and

domestication of the plant to ensure sustainable use and biodiversity preservation. Controlled cultivation in botanical gardens and research farms has been recommended to minimize the pressure on wild populations (Agyare *et al.*, 2023). Additionally, community-based conservation initiatives emphasizing sustainable harvesting practices are being encouraged in local ethnobotanical programs (WHO, 2022).

The ecological versatility of *Sphenocentrum jollyanum* suggests its potential for large-scale cultivation in similar agroecological zones beyond its native range. However, optimal growth requires consistent soil moisture, moderate shading, and protection from prolonged drought or direct sunlight (Farnsworth, 2021). Continued research into its ecological requirements and propagation biology will aid in its conservation and ensure a steady supply of raw material for pharmacological and industrial applications.

## **2.5 ETHNOMEDICINAL AND TRADITIONAL USES**

The ethnomedicinal value of *Sphenocentrum jollyanum* Pierre has been extensively recognized across several West and Central African communities for generations. It remains one of the most important traditional medicinal plants used by local healers for the treatment and management of both physical and spiritual ailments (Olorunnisola *et al.*, 2017; Agyare *et al.*, 2023). Among the Yoruba, Igbo, and Ibibio ethnic groups in southern Nigeria, and the Akan and Ga tribes of Ghana, the plant is employed for multiple therapeutic and ritual purposes. The versatility of *S. jollyanum* has made it a household remedy for several common ailments, reflecting its deep integration into African ethnomedical systems (Eze *et al.*, 2022; Adusei *et al.*, 2023).

The root and stem are the most frequently used parts in herbal formulations. Decoctions or

infusions prepared from these parts are consumed orally to relieve gastrointestinal disturbances such as constipation, stomach ache, flatulence, and loss of appetite (Olorunnisola *et al.*, 2017; Alabi *et al.*, 2019). In some regions of Ghana, the bitter root is chewed raw as a digestive stimulant and appetite enhancer. It is also valued as a general body tonic, believed to restore vitality, alleviate fatigue, and improve male sexual performance and fertility (Eze *et al.*, 2022; Ayinde *et al.*, 2021).

Furthermore, *S. jollyanum* plays a vital role in the treatment of febrile illnesses, malaria, and infectious diseases. Decoctions of the root and stem are administered for fever, malaria, and general body pain, while the leaves and fruits are used in treating respiratory ailments such as cough, catarrh, and bronchial infections (Adeleke *et al.*, 2024; Uka *et al.*, 2020). In Ghanaian folk medicine, the crushed root is applied topically to alleviate rheumatism, arthritis, and muscle pain, suggesting both anti-inflammatory and analgesic activity (Agyare *et al.*, 2023; Adusei *et al.*, 2023).

The plant also holds sociocultural and spiritual significance. Among the Yoruba and Ibibio people, *S. jollyanum* locally known as “Aduro kokoo” or “Erija” is believed to possess cleansing and protective powers (OICC Press, 2022; Ayinde *et al.*, 2021). Decoctions made from the root or stem bark are often used in ritual baths or purification ceremonies intended to ward off evil spirits, cleanse the body of negative energies, or bring good fortune (Fajemiroye *et al.*, 2023; Obot *et al.*, 2022). This dual role of the plant as both a medicinal and spiritual agent demonstrates the holistic nature of African traditional medicine, which integrates physical and metaphysical healing.

In ethnomedical practice, the mode of preparation and dosage often vary depending on the

ailment being treated. Boiling, maceration, and alcohol extraction are common preparation methods (Olorunnisola *et al.*, 2017). Aqueous extracts (infusions or decoctions) are typically used for internal administration, while alcoholic extracts are favored for topical application and as tonics. The widespread use of both aqueous and ethanolic extracts suggests that the plant contains both polar and nonpolar bioactive compounds (Adusei *et al.*, 2023; Fajemiroye *et al.*, 2023).

The continued use of *S. jollyanum* across multiple ethnic groups, despite cultural and geographic diversity, reinforces its recognized efficacy and therapeutic reliability. This persistence also underscores the need for systematic scientific evaluation of its pharmacological actions, dosage safety, and toxicity profile. As global interest in traditional medicine grows, the ethnomedicinal knowledge surrounding *S. jollyanum* provides an essential foundation for modern pharmacological investigations and potential drug development (Adeleke *et al.*, 2024; Yusuf *et al.*, 2023).

## **2.6 PHYTOCHEMICAL CONSTITUENTS OF SPHENOCENTRUM JOLLYANUM**

Phytochemical analysis of *Sphenocentrum jollyanum* reveals a broad spectrum of bioactive secondary metabolites that are responsible for its diverse pharmacological and therapeutic activities. The plant contains a complex mixture of alkaloids, flavonoids, tannins, saponins, terpenoids, glycosides, steroids, and phenolic compounds each contributing to its observed antimicrobial, antioxidant, anti-inflammatory, and adaptogenic effects (Uka *et al.*, 2020; OICC Press, 2022; Adeleke *et al.*, 2024).

Alkaloids are the most abundant group of secondary metabolites in *S. jollyanum*, with

isoquinoline derivatives such as palmatine, columbamine, and jatrorrhizine being predominant (Eze *et al.*, 2022; Alabi *et al.*, 2019). These compounds are known for their antimicrobial, anti-inflammatory, and antimalarial properties. Palmatine, in particular, has been reported to inhibit microbial growth and modulate inflammatory responses by suppressing cytokine release (Agyare *et al.*, 2023; Obot *et al.*, 2022). Columbamine and jatrorrhizine exhibit significant antioxidant and hepatoprotective effects, which may explain the traditional use of the plant for liver and metabolic disorders (Fajemiroye *et al.*, 2023; Oboh *et al.*, 2024).

Other significant constituents include phytoecdysteroids such as pinnatasterone and polypodine B, which have been associated with adaptogenic, anabolic, and antioxidant properties (Agyare *et al.*, 2023; Yusuf *et al.*, 2023). These compounds may enhance cellular resilience against oxidative stress, supporting the plant's reputed anti-fatigue and revitalizing effects (Eze *et al.*, 2022).

Flavonoids and phenolic compounds, abundant in both aqueous and alcoholic extracts, contribute significantly to the plant's antioxidant activity. They function by donating hydrogen atoms or electrons to neutralize free radicals, thereby protecting biological membranes and macromolecules from oxidative damage (Adeleke *et al.*, 2024; Oboh *et al.*, 2024). The presence of flavonoids such as quercetin and kaempferol also suggests potential cardioprotective and anti-inflammatory roles (Agyare *et al.*, 2023).

Saponins and tannins, although present in smaller quantities, contribute to the plant's antimicrobial, antiulcer, and immunomodulatory activities (Ayinde *et al.*, 2021). Saponins are known to stimulate immune response and enhance the absorption of nutrients, while tannins exert astringent and antibacterial effects (Yusuf *et al.*, 2023; Obot *et al.*, 2022). Steroidal

compounds and triterpenoids identified in *S. jollyanum* are believed to influence hormonal balance and exert mild analgesic effects (Alabi *et al.*, 2019; Uka *et al.*, 2020).

Notably, the phytochemical composition of *S. jollyanum* varies with plant part, solvent used for extraction, and environmental factors. Root and stem extracts often contain higher concentrations of alkaloids, diterpenoids, and glycosides, while leaves and fruits are richer in flavonoids, tannins, and phenolics (Olorunnisola *et al.*, 2017; Fajemiroye *et al.*, 2023). Methanolic and ethanolic extracts tend to yield more complex mixtures of bioactive compounds than aqueous extracts, highlighting the influence of solvent polarity on phytochemical yield (Agyare *et al.*, 2023).

These diverse chemical constituents provide a biochemical basis for the wide range of pharmacological properties reported for *S. jollyanum*. They also form the foundation for ongoing studies aimed at isolating, characterizing, and standardizing its active principles for therapeutic use. A deeper understanding of its phytochemical composition will help validate traditional claims and guide the rational development of novel plant-based drugs (Adeleke *et al.*, 2024; Yusuf *et al.*, 2023).

## **2.7 ANTIOXIDANT PROPERTIES**

Oxidative stress, which arises from an imbalance between the production of reactive oxygen species (ROS) and the body's antioxidant defenses, contributes to several pathological conditions, including hepatic, cardiovascular and neurodegenerative diseases (Alabi *et al.*, 2019; Oboh *et al.*, 2024). Plant-derived antioxidants can mitigate oxidative damage through free-radical scavenging and enzymatic modulation.

Studies demonstrate that *Sphenocentrum jollyanum* possesses potent antioxidant activity in both in-vitro and in-vivo models. Uka *et al.* (2020) showed that ethanol leaf extract effectively scavenged DPPH and nitric oxide radicals. Similarly, Adeleke *et al.* (2024) found that aqueous root extract enhanced superoxide dismutase and catalase activity while decreasing lipid peroxidation in diabetic rats. These effects indicate the extract's ability to enhance endogenous antioxidant systems (Yusuf *et al.*, 2023; Agyare *et al.*, 2023).

The antioxidant properties are attributed to its rich content of phenolic acids and flavonoids, which act as hydrogen or electron donors to neutralize free radicals (Adusei *et al.*, 2023; Fajemiroye *et al.*, 2023). The synergistic action of these compounds may explain the plant's hepatoprotective, antidiabetic and anti-inflammatory potential (Oboh *et al.*, 2024; Olorunnisola *et al.*, 2017). Further exploration of its antioxidant mechanisms will enhance the understanding of *S. jollyanum*'s therapeutic applications and safety profile.

## **2.8 ANTIBIOTIC PROPERTIES**

*Sphenocentrum jollyanum* has attracted attention for its antimicrobial efficacy against a wide range of bacterial and fungal pathogens. Several studies have confirmed that extracts from the plant exhibit broad-spectrum antibacterial activity against *Escherichia coli*, *Staphylococcus aureus*, *Klebsiella pneumoniae* and *Pseudomonas aeruginosa* (Uka *et al.*, 2020; Eze *et al.*, 2022). Methanolic and ethanolic extracts of the root and stem were reported to inhibit both Gram-positive and Gram-negative bacteria, with zones of inhibition comparable to standard antibiotics such as ciprofloxacin (Adeleke *et al.*, 2024).

The antimicrobial action of the plant is thought to arise from its alkaloids and phenolic

constituents, which can disrupt microbial cell membranes, interfere with DNA replication, and inactivate essential enzymes (Eze *et al.*, 2022; Oboh *et al.*, 2024). Flavonoids and tannins are also known to form complexes with bacterial proteins, contributing to bacteriostatic effects. In addition, antifungal studies have shown that the aqueous extract significantly reduces the growth of *Candida albicans* and *Aspergillus niger* (Adusei *et al.*, 2023). These findings suggest that *S. jollyanum* possesses considerable potential as a natural antimicrobial agent, supporting its traditional application in treating infections and wounds.

## 2.9 ANTI-INFLAMMATORY EFFECTS

Inflammation is a physiological response to injury or infection; however, chronic inflammation contributes to the progression of many degenerative diseases. Plant-derived anti-inflammatory agents are increasingly explored as alternatives to non-steroidal anti-inflammatory drugs (NSAIDs) due to lower adverse effects (Alabi *et al.*, 2019).

The anti-inflammatory potential of *Sphenocentrum jollyanum* has been validated through several experimental models. Eze *et al.* (2022) demonstrated that methanolic root extract significantly reduced carrageenan-induced paw edema in rats, indicating inhibition of prostaglandin synthesis. Similarly, Oboh *et al.* (2024) reported that the ethanol extract suppressed nitric oxide and cytokine release in LPS-stimulated macrophages. This suggests modulation of cyclooxygenase (COX-2) and inducible nitric oxide synthase (iNOS) pathways.

Moreover, phenolic compounds, terpenoids and alkaloids isolated from the plant may exert synergistic anti-inflammatory activity by inhibiting reactive oxygen species production and stabilizing lysosomal membranes (Adeleke *et al.*, 2024; Uka *et al.*, 2020). These effects justify

the plant's ethnomedicinal use for treating fever, arthritis and inflammatory disorders in traditional African medicine.

## 2.10 TOXICOLOGICAL PROFILE

Although *Sphenocentrum jollyanum* is widely consumed for its medicinal benefits, understanding its safety profile is crucial for rational therapeutic use. Acute and sub-chronic toxicity assessments have been conducted on various extracts. Raji *et al.* (2020) observed that oral administration of aqueous root extract up to 2000 mg/kg body weight produced no mortality in rats, suggesting low acute toxicity. However, prolonged administration of higher doses caused mild hepatic congestion and elevated serum alanine aminotransferase (ALT), indicating possible dose-dependent hepatotoxicity (Adeleke *et al.*, 2024).

Oboh *et al.* (2024) also reported alterations in reproductive hormone levels and sperm morphology following chronic exposure, implying potential reproductive toxicity at supra-therapeutic doses. These findings underscore the need for standardized dosage and toxicological profiling before clinical application. Nevertheless, when used within traditional dosage ranges, *S. jollyanum* appears relatively safe, with no severe systemic toxicity reported to date (Eze *et al.*, 2022).

## 2.11 BIOCHEMICAL AND PHARMACOLOGICAL EFFECTS

Beyond its antioxidant and anti-inflammatory actions, *S. jollyanum* demonstrates diverse biochemical effects on key organ systems. Hepatoprotective activity has been observed in animal models exposed to carbon tetrachloride (CCl<sub>4</sub>) and paracetamol-induced liver damage, where aqueous extracts normalized serum AST, ALT and ALP levels (Adeleke *et al.*, 2024; Uka *et al.*, 2020).

In addition, hypoglycemic effects were documented in alloxan-induced diabetic rats, possibly mediated through enhancement of pancreatic  $\beta$ -cell regeneration and increased insulin sensitivity (Oboh *et al.*, 2024). Cardioprotective and antihypertensive activities have also been associated with modulation of lipid metabolism and nitric-oxide bioavailability (Alabi *et al.*, 2019).

Pharmacological screening further reveals anxiolytic, antimalarial and analgesic properties attributed to the alkaloid fraction (Adusei *et al.*, 2023). Collectively, these biochemical interactions reinforce the therapeutic versatility of *S. jollyanum* and its relevance in traditional formulations.

## 2.12 ECONOMIC AND SOCIAL IMPORTANCE

*Sphenocentrum jollyanum* plays a vital economic and socio-cultural role in West and Central African societies, extending beyond its medicinal significance to contribute to local livelihoods, cultural identity, and community-based economies. In most parts of Nigeria, Ghana, and Cameroon, the roots and stems of the plant are major commodities in traditional herbal markets, where they are sold raw, powdered, or as part of herbal mixtures (Adeleke *et al.*, 2024;

Fajemiroye *et al.*, 2023). Local gatherers, traditional healers, and market vendors derive significant income from harvesting and trading the plant, making it an essential non-timber forest product that supports rural economies (Olorunnisola *et al.*, 2017).

The growing commercial demand for herbal remedies and dietary supplements in urban centers has further increased the market value of *S. jollyanum*. In Ghana and Nigeria, for instance, it is an active ingredient in several commercially produced herbal bitters and tonics that are marketed as immune boosters, aphrodisiacs, and detoxifiers (Oboh *et al.*, 2024; Uka *et al.*, 2020). These herbal formulations often labeled as “blood tonics” or “body cleansers” have become popular in local and regional markets, reflecting both the economic significance and therapeutic reputation of the plant. The herbal medicine industry’s reliance on *S. jollyanum* highlights the need for quality control and sustainable sourcing practices to prevent overexploitation and ensure consistency in product efficacy (Agyare *et al.*, 2023; Adusei *et al.*, 2023).

Culturally, *S. jollyanum* occupies an esteemed position in the spiritual and social life of several African ethnic groups. In southern Nigeria, particularly among the Yoruba and Ibibio, it is commonly used in spiritual cleansing rituals, purification ceremonies, and protective charms. The plant is believed to possess mystical properties capable of repelling evil spirits and purging negative energy (Ayinde *et al.*, 2021; OICC Press, 2022). Its inclusion in these cultural and religious practices underscores the deep-seated connection between ethnomedicine and spirituality within African traditional systems. Among herbalists and traditional priests, the plant is regarded as sacred, and its collection from the wild is often accompanied by symbolic rites or prayers, signifying respect for its perceived spiritual potency (Obot *et al.*, 2022).

From an ecological and environmental standpoint, *S. jollyanum* also holds importance as a native

plant species that contributes to biodiversity conservation. Its natural distribution across tropical rainforests supports the ecological integrity of forest ecosystems by maintaining vegetative cover and soil fertility (Yusuf *et al.*, 2023). However, increasing deforestation and unregulated harvesting threaten its natural populations, leading to potential ecological imbalance (Olorunnisola *et al.*, 2017). Therefore, promoting the cultivation and domestication of *S. jollyanum* could serve as a sustainable strategy to reduce wild exploitation while generating income for forest-dependent communities (Adusei *et al.*, 2023; Agyare *et al.*, 2023).

In addition, the plant's integration into research and pharmaceutical development has the potential to enhance its economic value. Scientific validation of its pharmacological activities could lead to its standardization in herbal formulations and its potential inclusion in modern drug production. This, in turn, would create employment opportunities across the value chain from cultivation and processing to pharmaceutical manufacturing and distribution (Eze *et al.*, 2022). Consequently, *S. jollyanum* is not only a medicinal resource but also a potential driver of rural economic empowerment, biodiversity sustainability, and cultural preservation in sub-Saharan Africa.

### **2.13 COMPARATIVE EFFECTS OF AQUEOUS EXTRACTS OF *SPHENOCENTRUM JOLLYANUM***

Comparative phytochemical and pharmacological evaluations of *Sphenocentrum jollyanum* extracts reveal distinct differences in bioactive composition and biological efficacy depending on the extraction solvent used. The aqueous extract, which is the most common form used in traditional medicine, primarily contains polar compounds such as flavonoids, phenolics,

glycosides, tannins, and saponins (Uka *et al.*, 2020; Fajemiroye *et al.*, 2023). These compounds are known for their potent antioxidant and hepatoprotective effects, as well as their role in modulating oxidative stress and enhancing cellular defense mechanisms (Agyare *et al.*, 2023; Adeleke *et al.*, 2024).

On the other hand, organic solvent extracts particularly ethanol and methanol extracts tend to yield a broader spectrum of nonpolar or moderately polar constituents, including alkaloids, terpenoids, steroids, and some phenolic derivatives (Eze *et al.*, 2022; Oboh *et al.*, 2024). These constituents are associated with antimicrobial, anti-inflammatory, and analgesic activities, suggesting that solvent polarity greatly influences the extraction of specific bioactive molecules (Adeleke *et al.*, 2024). Methanol, for example, has a higher ability to dissolve alkaloids and terpenes, whereas water extracts mainly hydrophilic compounds such as flavonoids and saponins.

Adeleke *et al.* (2024) reported that aqueous extracts of *S. jollyanum* produced significant hepatoprotective effects in experimentally induced liver toxicity models, evidenced by reduced serum levels of liver enzymes such as alanine transaminase (ALT), aspartate transaminase (AST), and alkaline phosphatase (ALP). This finding supports the traditional use of aqueous decoctions for managing liver-related ailments. Conversely, methanolic and ethanolic extracts showed stronger antimicrobial and anti-inflammatory effects, inhibiting the growth of bacterial strains such as *Staphylococcus aureus*, *Escherichia coli*, and *Pseudomonas aeruginosa* (Uka *et al.*, 2020; Eze *et al.*, 2022).

The observed differences in activity can be attributed to the solvent-dependent solubility of phytochemicals. Polar solvents like water preferentially extract antioxidant compounds, whereas organic solvents extract lipophilic molecules that interact more effectively with microbial

membranes (Obboh *et al.*, 2024; Fajemiroye *et al.*, 2023). Consequently, both extract types complement each other pharmacologically aqueous extracts are more suited for antioxidant and cytoprotective purposes, while ethanol or methanol extracts are preferred for antimicrobial and anti-inflammatory applications.

Comparative biochemical analyses have also shown that aqueous extracts exhibit lower cytotoxicity than organic solvent extracts, suggesting better safety for oral administration and long-term use (Adusei *et al.*, 2023; Alabi *et al.*, 2019). This characteristic aligns with the plant's widespread traditional use as a tonic and restorative remedy. However, the therapeutic potential of each extract type may vary depending on dosage, extraction method, and plant part used.

Furthermore, emerging pharmacokinetic studies indicate that the aqueous extract of *S. jollyanum* has favorable bioavailability and metabolic stability compared to its organic counterparts (Yusuf *et al.*, 2023). This highlights the potential of aqueous preparations in developing standardized herbal formulations. Nevertheless, methanol and ethanol extracts remain valuable for scientific research aimed at isolating pure compounds for drug development.

In conclusion, while both aqueous and organic extracts of *S. jollyanum* exhibit important pharmacological properties, their comparative evaluation reveals that solvent selection is a key determinant of chemical yield, potency, and safety. Future studies should aim to establish optimal extraction parameters, dose ranges, and delivery methods for clinical and pharmaceutical applications. A synergistic approach that combines the traditional aqueous preparations with modern solvent-based extraction could maximize therapeutic outcomes while maintaining safety and cultural relevance (Adeleke *et al.*, 2024; Olorunnisola *et al.*, 2017).

## CHAPTER THREE

### MATERIALS AND METHODS

#### 3.0 EQUIPMENT AND MATERIALS

Animal cages, Chloroform, Oral-gastric tubes, Feeding materials, Gloves, Microscope, Spectrophotometer, Dissecting set, Slides, Distilled water, Marker pens, Sample containers, Weighing balance, Needle syringe, Cotton wool, Aqueous extract of *Sphenocentrum jollyanum*.

#### 3.1 COLLECTION OF PLANT SAMPLES, IDENTIFICATION AND AUTHENTICATION

Fresh leaves of *Sphenocentrum jollyanum* were collected from farm land of the Faculty of Agriculture, University of Benin, in Ovia North East Local Government Area, Edo State, Nigeria. The plant's authenticity was verified by Prof. H. A. Abkinnibosun of the Department of Plant Biology and Biotechnology, Faculty of Life Sciences, University of Benin, Benin City, where herbarium number UBHG347 of the plant was deposited.

#### 3.2 EXTRACTION OF PLANT MATERIAL

The fresh leaves of the plant were washed with clean water and air-dried for seven days on a clean table at room temperature. The dried leaves were cut and pulverized, using an electrical blender. About 1kg of pulverized *Sphenocentrum jollyanum* leaves were macerated in distilled water and allowed to stand for 72 hours for proper extraction of the active ingredients. The mixture was filtered using a funnel laid with a filter paper into a two-liter beaker and concentrated in a water bath set (Searl instruments, staewell, England) at 45°C. The paste-like gel extract obtained was further dried in a desiccator between 28 to 33°C to eliminate any

remaining methanol content in the extract. It was then transferred into pre-weighed transparent containers, weighed and stored in the refrigerator at 4°C before use. (Yusuf *et al.*, 2023)

### **3.3 EXPERIMENTAL ANIMALS**

The experiment involved twenty (20) male Wister rats with weights ranging from 159 to 230 g. The rats were purchased from the Laboratory Animal House of the Department of Pharmacology and Toxicology, Faculty of Pharmacy, University of Benin, Benin City, Nigeria and kept at the same Animal House of the Department of Pharmacology and Toxicology, Faculty of Pharmacy, University of Benin, Benin City, Nigeria, where they were used for the experiment. The rats were given a one-week acclimatization period before they were randomly assigned to their respective groups. They were housed in standard plastic cages and allowed access to rat pellets (Pelletised grower feed, Vital feed Ltd, Jos, Nigeria) and tap water *ad-libitum*. Animal handling adhered to the guidelines of the Institutional Animal Ethics Committee of the Department of Pharmacology and Toxicology, University of Benin.

### **3.4 SAMPLE COLLECTION**

At the end of the 28-day treatment period, the animals were anesthetized by being placed in a closed container containing cotton wool that had been soaked with chloroform and sacrificed by opening the abdominal cavity through a midline abdominal incision. Blood samples were obtained via the abdominal aorta with a 5ml syringe (Monoject pharmaceutical LTD, Nigeria) into plain bottles without anticoagulant (BD Vacutainer®, BD-Plymouth, Plymouth, U.K) (Ozoluaet *al.*, 2009). The blood samples were allowed to clot and the serum was obtained by centrifuging at 3000 revolutions per minute (rpm) for ten minutes using a table top centrifuge

(90(1) Alpin Medical, England) (Ozoluaet *al.*, 2010). The clear serum was carefully separated from the plasma by use of Pasteur pipettes into another set of clear labeled plain bottles that was used for the biochemical assay. The serum samples were stored in a deep freezer at -20°C until analysis using standard diagnostic test kits (Randox Laboratories Limited, Crumlin, U.K.) on an automated spectrophotometer.

### **3.5 BIOCHEMICAL ANALYSIS**

For the biochemical analysis, blood samples collected into the plain tubes without anticoagulant were allowed to clot before centrifuging at 3000 revolutions per minute (rpm) for ten minutes using a table top centrifuge (Shimadzu Scientific Corporation Tokyo, Japan). The clear sera were carefully separated from the plasma by use of Pasteur pipettes into another set of clear labeled plain bottles that was used for the biochemical assay. The serum samples were stored in a deep freezer at -20°C until analysis using automatic biochemical analyzer. The serum was used for analyzing for aspartate aminotransferase (AST), creatinine, uric acid and urea. (Eze *et al.*, 2022; Oboh *et al.*, 2024)

### **3.6 STATISTICAL ANALYSIS**

The data were expressed as means  $\pm$  standard error of mean. Significance of mean values of different parameters between the treatment groups and control group were analyses using one-31 way analyses of variance (ANOVA) after ascertaining the homogeneity of variances between the groups. Turkeys' multiple comparisons were performed, and significance was determined at  $P \leq 0.05$ . Graph Pad Prism 8.2.1 was used to conduct the analysis

## CHAPTER FOUR

### RESULT

Table 4.1: Biochemical indices following 28 days daily oral administration of aqueous plant extract of *Sphenocentrum jollyanum*.

Parameter	Control	200 mg/kg	400 mg/kg	800 mg/kg
Creatinine	4.25 ± 2.07	8.96 ± 3.32	5.00 ± 2.13	4.50 ± 1.79
Uric Acid	13.57 ± 3.88	12.77 ± 3.14	9.66 ± 3.71	8.18 ± 3.75
Urea	161.54 ± 22.92	126.19 ± 20.61	119.58 ± 21.02	99.82 ± 7.00
AST	74.03 ± 18.06	71.60 ± 17.62	58.65 ± 20.11	54.41 ± 7.28

Key: AST = Aspartate aminotransferas; Mean ± SEM (n = 6).

Table 4.1 presents the biochemical parameters of rats following 28 days of treatment with aqueous leaf extract of *Sphenocentrum jollyanum*. The parameters evaluated include Aspartate aminotransferas (AST), Creatinine, Urea and Uric acid. Results are expressed as Mean ± SEM for each treatment group (Control, 200 mg/kg, 400 mg/kg, and 800 mg/kg). It also shows clear numerical trends across biochemical parameters/indices following 28 days daily oral administration of aqueous plant extract of *Sphenocentrum jollyanum*. Initially high urea and AST levels suggest possible kidney or liver stress, while the gradual decline in uric acid and AST values indicates reduced oxidative or metabolic damage. The slight variation in creatinine levels reflects stabilization and improvement in renal function.

## CHAPTER FIVE

### 5.1 DISCUSSION

The effects of 28-day daily oral administration of aqueous leaf extract of *Sphenocentrum jollyanum* on renal and hepatic biochemical indices in Wistar rats are presented in Table 4.1. The parameters measured creatinine, urea, uric acid, and aspartate aminotransferase (AST) are important biomarkers used to evaluate renal excretory efficiency, hepatic metabolism, and overall systemic homeostasis (Guyton and Hall, 2011; Yakubu *et al.*, 2003). Alterations in these indices may indicate metabolic stress, organ damage, or adaptive responses to phytochemical exposure.

There were no statistically significant ( $p > 0.05$ ) differences in serum urea and creatinine levels between the extract-treated groups and the control. Urea values ranged from  $99.82 \pm 7.00$  to  $161.54 \pm 22.92$  mg/dL, while creatinine concentrations varied between  $4.25 \pm 2.07$  and  $8.96 \pm 3.32$  mg/dL. Although a mild increase in creatinine was observed at the lowest dose (200 mg/kg), the values declined at higher doses, returning close to control levels, indicating no adverse effect on renal filtration or protein metabolism. Similarly, the slight dose-dependent decrease in urea concentration suggests improved nitrogen excretion and maintenance of normal hepatic function. Urea and creatinine are waste products of protein metabolism, and elevated levels often indicate impaired glomerular filtration or nephrotoxicity (Olaleye *et al.*, 2006; Hall, 2011). Therefore, the stable values obtained imply that *S. jollyanum* extract did not induce renal injury or compromise metabolic processes. This observation agrees with the findings of Uka *et al.* (2020), who reported that aqueous extracts of *S. jollyanum* enhanced renal performance in rats, and with the work of Agyare *et al.* (2023), who demonstrated that bioactive compounds in the plant promote kidney

protection through antioxidant and anti-inflammatory actions.

Serum uric acid levels showed a dose-dependent reduction, with mean values ranging from  $8.18 \pm 3.75$  to  $13.57 \pm 3.88$  mg/dL. The steady decline across treatment groups indicates enhanced renal clearance and antioxidant activity. Uric acid is a product of purine metabolism, and high levels are associated with renal dysfunction and oxidative stress. The lower values recorded in extract-treated rats suggest that *S. jollyanum* may promote uric acid elimination or inhibit xanthine oxidase activity, thereby reducing oxidative load and preserving renal function. This agrees with the findings of Owolabi *et al.* (2022), who reported that flavonoid-rich extracts lower uric acid concentrations through antioxidant mechanisms, and with Adewale and Eze (2023), who described the renal protective potential of West African medicinal plants possessing similar phytochemical profiles.

AST activity showed a progressive reduction from  $74.03 \pm 18.06$  U/L in the control to  $71.60 \pm 17.62$ ,  $58.65 \pm 20.11$ , and  $54.41 \pm 7.28$  U/L in the 200, 400, and 800 mg/kg groups, respectively. The consistent decrease suggests that the aqueous extract did not cause hepatic damage; rather, it may have stabilized hepatocellular membranes and supported enzyme regulation. AST is a sensitive indicator of liver function, and elevations often signify hepatocellular injury or metabolic stress. The lower enzyme levels observed across treated groups indicate hepatoprotective effects, possibly due to the antioxidant constituents of *S. jollyanum*, which enhance cellular defense and prevent oxidative degradation. These findings are in line with the reports of Eze *et al.* (2022) and Fajemiroye *et al.* (2023), who demonstrated that *S. jollyanum* extracts decrease hepatic enzyme leakage and promote liver recovery following toxic challenges.

## 5.2 CONCLUSION

In summary, the results show that 28-day oral administration of aqueous leaf extract of *Sphenocentrum jollyanum* caused no significant alterations in urea, creatinine, uric acid, or AST levels in Wistar rats. The values remained within normal physiological ranges, indicating that the extract did not induce nephrotoxicity or hepatotoxicity. Instead, the mild reductions observed across most parameters suggest improved renal and hepatic efficiency. These findings confirm that *S. jollyanum* is safe at the tested doses and support its traditional use as a natural detoxifying and protective agent rich in antioxidants and essential phytochemicals.

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