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REVIEW

Sphenocentrum Jollyanum: Pharmacological Insights Into a Neglected African Medicinal Plant

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ABSTRACT

Sphenocentrum jollyanum Pierre (Menispermaceae) is a West African medicinal plant used traditionally for various ailments, including malaria, diabetes, and reproductive disorders. Despite its ethnobotanical significance, comprehensive scientific validation of its pharmacological properties remains limited. This review aims to provide a comprehensive overview of the plant's ethnobotany, phytochemistry, and pharmacological activities, integrating traditional knowledge with modern scientific insights to guide future research. A comprehensive literature search was conducted in PubMed, ScienceDirect, Scopus, Google Scholar, and Web of Science, covering publications up to April 2025. Search terms included "Sphenocentrum jollyanum", "ethnobotanical use", "pharmacological effects", and related keywords. Relevant articles were screened, and data on traditional uses, phytochemistry, and pharmacological activities were extracted. *S. jollyanum* is a rich source of diverse phytochemicals, including alkaloids, flavonoids, terpenoids, tannins, and saponins, which contribute to its various pharmacological activities. Scientific studies support its traditional uses, demonstrating antioxidant, anti-inflammatory, antidiabetic, hepatoprotective, and aphrodisiac effects. Specifically, extracts and isolated compounds have shown promising activity in in vitro and in vivo models. However, significant gaps remain regarding its toxicological profile, mechanisms of action, and pharmacokinetic properties. *S. jollyanum* holds considerable therapeutic potential, supported by its ethnobotanical uses and promising pharmacological activities. Further research is essential to elucidate its mechanisms of action, assess its safety and toxicity, and explore its clinical applications.

Keywords: Sphenocentrum jollyanum, Ethnobotany, Phytochemistry, Pharmacology, Medicinal plant

1. Introduction

The African continent is home to a diverse flora with immense therapeutic potential, yet many indigenous medicinal plants remain underexplored in modern pharmacological research. Among these is *Sphenocentrum jollyanum* Pierre (family: Menispermaceae), a woody shrub native to the tropical rainforests of West and Central Africa. Traditionally employed in countries such as Nigeria, Ghana, and Cameroon, the plant has been used in the management of various ailments including malaria, diabetes, reproductive disorders, and hepatic dysfunctions [1]. Despite its widespread ethnomedical use, *S. jollyanum* has not received adequate scientific scrutiny compared to other African medicinal plants. However, emerging studies suggest that the plant possesses a broad spectrum of bioactivities, attributed to its rich reservoir of phytochemicals including alkaloids (e.g., jollyanine, magnoflorine), flavonoids, saponins, and terpenoids [2]. These compounds have been implicated in antioxidant, anti-inflammatory, antidiabetic, hepato-protective, and aphrodisiac effects in both in vitro and in vivo models [2]. The recent surge of interest in phytotherapeutics has brought to light the necessity of documenting and validating the pharmacological properties of underutilized species. While preliminary pharmacological studies on *S. jollyanum* indicate promising therapeutic outcomes, critical knowledge gaps persist, particularly regarding its toxicological profile, mechanism of action, and pharmacokinetic

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behavior. The recent surge of interest in phytotherapeutics highlights the necessity of documenting and validating the pharmacological properties of underutilized species. This review aims to provide a comprehensive overview of the pharmacological landscape of Sphenocentrum jollyanum, encompassing its ethnobotanical background, phytochemical composition, validated bioactivities, and potential applications in drug discovery. Emphasis is placed on integrating traditional knowledge with modern pharmacological insights to establish a framework for future scientific and clinical investigations.

2. Methodology

A comprehensive literature search was performed across major electronic scientific databases including PubMed, ScienceDirect, Scopus, Google Scholar, and Web of Science. The search covered publications from inception through April 2025, using combinations of the following keywords: "Sphenocentrum jollyanum", “ethnobotanical use”, “traditional use”, “pharmacological effects”, “pharmacological studies”, "toxicity", "toxicological profile", "acute toxicity", "sub-chronic toxicity", "LD50", "reproductive toxicity", "safety assessment", and "herb-drug interactions". Boolean operators (AND, OR) and Medical Subject Headings (MeSH) were used to refine the search. The search was supplemented with manual screening of reference lists from relevant articles to capture additional studies not indexed in databases.

3. Plant description

Sphenocentrum jollyanum Pierre belongs to the family Menispermaceae, a family known for its climbing shrubs and potent alkaloid content, many of which have medicinal relevance. It is the sole species in the genus Sphenocentrum, making it monotypic. The plant is known by various local names, reflecting its cultural integration. It is called “Akerejupon” In indigenous Yoruba language, “Ezeogwu” in Igbo language, “Oban Abe” in Edo state, and Orji-nkoro in Izzi language of Ebonyi State, Nigeria [3]. In Ghana, it is commonly referred to as "Aduro kokoo" (red medicine) or "Okramankote" (dog’s penis), reflecting its traditional use and local significance. In southwestern Nigeria, the plant is known as "Akerejupon" or "Ajo" [2].

3.1. Morphological characteristics

S. jollyanum is a perennial, woody shrub that can grow either erect or as a scrambling plant, typically reaching heights of about 1.5 meters [4]. It thrives in the shaded, moist understory of tropical rainforests and is commonly found along stream banks and in forest clearings. The leaves are simple, alternate, and ovate to elliptic, typically measuring between 5–15 cm in length (Fig. 1). They are bright green with distinct venation and a smooth margin. The stem is initially green and angular, turning woody and brownish with age. The plant is dioecious, bearing unisexual flowers on separate male and female plants. The flowers are small, greenish-yellow, and borne in racemes or panicles. Its fruit is a fleshy, ovoid drupe, bright yellow to orange when ripe, typically 2–3 cm in length, and each contains a single seed (Fig. 1). The roots are thick, aromatic, and yellowish, and are often the most commonly harvested part due to their widespread medicinal applications [2].

3.2. Geographical distribution and habitat

S. jollyanum Pierre is a tropical shrub native to the dense rainforest zones of West Africa. It is widely distributed in countries such as Sierra Leone, Nigeria, Ghana, Côte d’Ivoire, and Cameroon [2, 5]. The plant thrives in regions characterized by high humidity and consistent rainfall, typically with an annual precipitation exceeding 1800 mm. It is commonly found in areas with mean minimum temperatures of 20°C and maximum temperatures of 29°C, making it well-suited to tropical climates [2]. This species predominantly grows as an undergrowth in dense forests, thriving in shaded environments from sea level up to altitudes of 400 meters above sea level [2]. Its ecological adaptability allows it to flourish in areas with limited sunlight under forest canopies. *S. jollyanum* is often found growing wild rather than being cultivated, reflecting its resilience and ability to survive without human intervention [4].

4. Ethnobotanical and traditional uses

S. jollyanum has been extensively utilized in traditional medicine across West Africa for the treatment and management of various ailments. The plant’s roots are commonly used as chew sticks to relieve stomachache, constipation, and boost appetite. In Côte d’Ivoire, the root is pulped into a paste mixed with salt, palm oil, and fruit of *Aframomum melegueta* to treat abdominal disorders [3, 6]. Decoctions of the root have been traditionally employed in malaria management, and as an aphrodisiac tonic for men to enhance sexual drive and increase testosterone levels [3, 6]. The plant’s leaves and bark are also utilized; decoctions from leafy twigs are used as

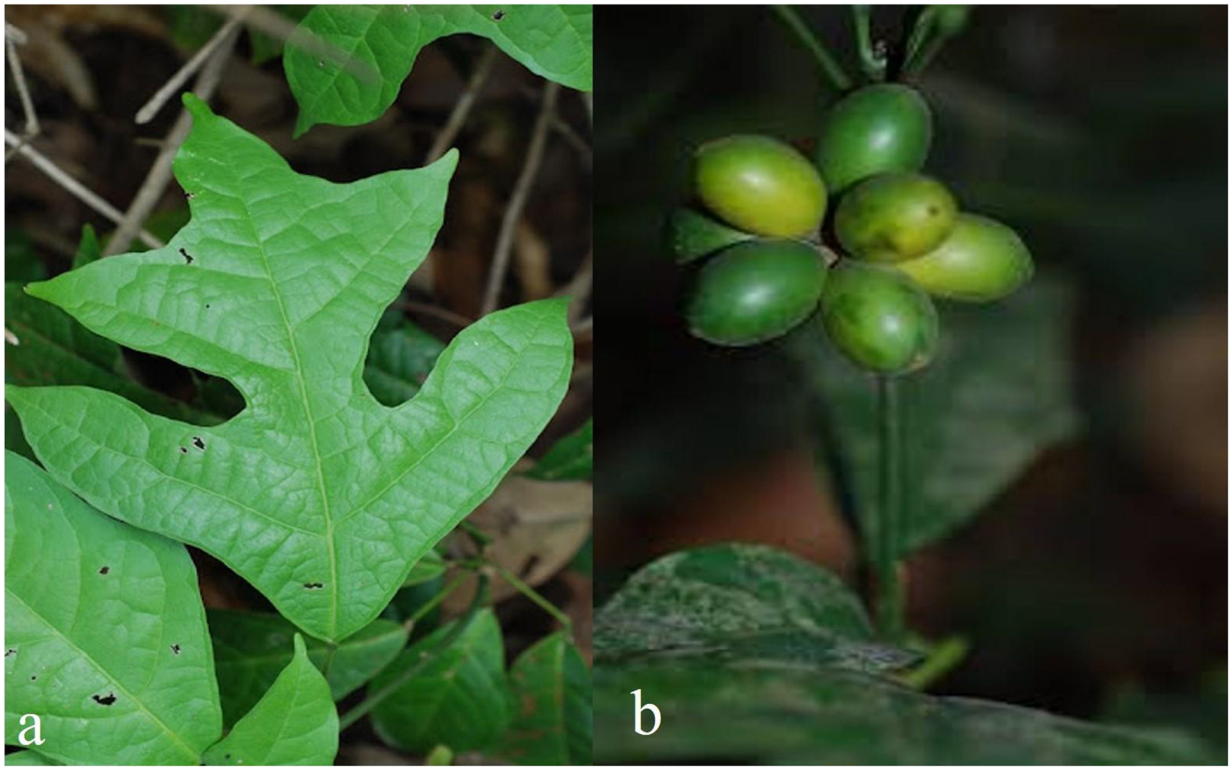

Fig. 1. Leaves (a) and fruits (b) of *S. jollyanum.*

washes to stop bleeding from wounds, sores, and cuts, while powdered bark is applied directly to wounds for faster healing [2, 6]. The fruit of *S. jollyanum* is consumed to alleviate fatigue and is sometimes taken with lemon or Piper guineense fruits to cure coughs [6]. In Ghana, pulped roots have been applied to treat breast tumors [3, 6]. Pounded roots are traditionally used to manage high blood pressure [2, 6]. Boiled or pulped roots are administered as draughts or enemas against epileptic fits [6].

The plant also has other uses beyond medicine. The roots are used as sweeteners; although sour when chewed, they make subsequent foods taste sweet. Additionally, the plant is employed as a purgative and emetic, especially when poisoning is suspected [3, 6]. These diverse applications highlight the plant's cultural and medicinal importance in traditional practices across West Africa. Thus, the use of *S. jollyanum* Pierre has evolved significantly over time, transitioning from traditional ethnomedicine to being recognized for its pharmacological potential in modern scientific research (Table 1).

5. Phytoconstituents

S. jollyanum Pierre is a rich source of secondary metabolites, which contribute to its diverse pharmacological activities. Phytochemical analyses have identified several bioactive compounds in various parts of the plant, as shown in Fig. 2, particularly the root. These compounds include alkaloids, phenols, flavonoids, terpenoids, tannins, steroids, saponins, and glycosides. Among these, alkaloids are the most abundant phytochemicals in *S. jollyanum*, with concentrations as high as 3782.64 mg/100g in ethanol root extracts [3]. These compounds are known for their antimalarial, analgesic, and stimulant properties.

Phenolic compounds are present at significant levels (2494.62 mg/100g) and are associated with antioxidant activities that protect against oxidative stress-related conditions [3]. Terpenoids (912.12 mg/100g) exhibit anti-inflammatory and hepatoprotective effects, while flavonoids (856.10 mg/100g) are known for their anti-diabetic and anti-inflammatory properties [2, 3]. Steroids (55.84 mg/100g) contribute to the plant's anti-inflammatory and hormonal modulation activities. Tannins, although present in smaller quantities (9.80 mg/100g), are linked to antimicrobial and wound-healing properties [3]. Saponins and glycosides were not detected in ethanol root extracts during some analyses, although they have been reported in other parts of the plant in separate studies [7].

A detailed phytochemical analysis of the essential oil from *S. jollyanum* root using gas

chromatography-mass spectrometry (GC-MS), identified 19 volatile constituents. These included prominent monoterpenoids such as α-pinene, γ-terpinene, and camphene, and sesquiterpenoids like α-eudesmol, isocaryophyllene, and globulol. Quantitatively, the essential oil was composed of approximately 33.5% monoterpenoids and 56.3% sesquiterpenoids, with the remaining 10.2% of constituents unidentified [8]. Earlier literature had already confirmed the presence three furanoditerpenes—columbin, isocolumbine, and fibleucin—as well as a protoberberine alkaloid [9]. The root contains two new phytoecdysteroidal glycosides, Sphenocentroside A and B, along with four known phytoecdysteroids: polypodoaurein, polypodine B, ecdysterone, and 20,26-dihydroxyecdysone, identified through NMR, IR, and MS spectral analyses [10]. GC-MS analysis of the crude ethanol root extract and fractions were reported to contain hexadecanoic acid, oleic acid, nonanoic acid methyl ester, 1, 2-benzenedicarboxylic acid, and bis (8-methylnonyl) ester [11]. Similarly, the ethanol extract of the contains a diverse array of bioactive compounds, including cyclohexene, 6-butyl-1-nitro, Z-8-Methyl-9-tetradecenoic acid, Methyl 9,12-heptadecadienoate, 2,4-Di-tert-butylphenol, Phenol, 3,5-bis(1,1-dimethylethyl), Cetene, 1-Hexadecanol, Trifluoroacetic acid, n-tridecyl ester, n-Decanoic acid, n-Hexadecanoic acid, L-Galactose, 6-deoxy-, 5-Eicosene, (E)-, 3-Eicosene, (E)-, 1-Octadecene, Dibutyl phthalate, 1,2-Benzenedicarboxylic acid, butyl 2-methylpropyl ester, 1,2-Benzenedicarboxylic acid, butyl 2-ethylhexyl ester, Hexadecanoic acid, ethyl ester, Undecanoic acid, ethyl ester, 9-Oxabicyclo[6.1.0]nonane, cis-, 2-Methyl-Z,Z-3,13-octadecadienol, 8-Dodecen-1-ol, (Z)-, Phytol, Oleic acid, cis-11-Hexadecenal, 9,17-Octadecadienal, (Z)-, cis-7, cis-11-Hexadecadien-1-yl acetate, 6,9,12-Octadecatrien-1-ol, Ethanol, 2-(9,12-octadecadienyloxy)-(Z,Z)-, trans-13-Octadecenoic acid, 1-Eicosene, Diisooctyl phthalate, Bis(2-ethylhexyl) phthalate, Cyclohexene, 4-(4-ethylcyclohexyl)-1-pentyl, 9-Octadecenoic acid (Z)-, 2,3-dihydroxypropyl ester, 9-Oxabicyclo[6.1.0]nonane, 9-Octadecenoic acid (Z)-, 2-hydroxy-1(hydroxymethyl)ethyl ester, and 9,12-Octadecadien-1-ol (Z,Z) [12].

6. Proximate composition

In addition to its phytochemicals, *S. jollyanum* root contains nutritional components such as carbohydrates (77.26%), protein (7.35%), moisture (6.37%), ash (3.49%), fiber (2.88%), and fat (2.64%) [3]. Proximate composition analysis revealed the seeds to be nutritionally dense, comprising 9.65% crude fat, 16.70% moisture, 48.09% crude protein, 16.79% carbohydrates, 3.26% ash, and 5.51% fiber. The calculated energy yield stood at 1460 kcal per 100 kg, highlighting the seeds as a potential dietary supplement with significant calorific value [13]. Moreover, mineral analysis through flame photometry and atomic absorption spectrophotometry (AAS) showed substantial levels of both macro and micro elements critical for human health. These included calcium, magnesium, potassium, iron, manganese, zinc, and sodium [13, 14]. The gross energy of *S. jollyanum* is relatively low at 1.3 Kcal/g, which is less than other forest tree seeds that range from 6-57 Kcal/g [14].

7. Pharmacological activities

7.1. Antioxidant activity

Multiple studies have demonstrated the antioxidant potential of Sphenocentrum jollyanum, highlighting its ability to combat oxidative stress and protect biological systems. The methanolic stem bark extract showed significant antioxidant activity in carbon tetrachloride (CCl_4)-induced oxidative stress in rats. It restored the activities of key antioxidant enzymes such as superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx), and glutathione S-transferase (GST). The extract also reduced lipid peroxidation and elevated serum marker enzymes like AST, ALT, and ALP, indicating protection against liver damage [37]. In vitro assays revealed strong scavenging activity against superoxide anions (IC_{50} = 13.11 μg/ml) and hydrogen peroxide radicals (IC_{50} = 30.04 μg/ml), comparable to ascorbic acid [37]. Methanolic leaf extract improved antioxidant enzyme levels in Plasmodium berghei-infected mice, including SOD, CAT, and glutathione (GSH). It also reduced malondialdehyde (MDA) concentrations, a marker of lipid peroxidation, suggesting a protective role against oxidative stress caused by malaria [15]. Among various plant organs tested, the stem bark exhibited the highest antioxidant activity in DPPH assays with an IC_{50} value of 1.80 $\pm$ 0.25 μg/ml, outperforming other fractions such as n-butanol and ethyl acetate. This suggests the stem bark is the most potent source of antioxidants within the plant [7].

The reported effects could be attributed to the plant's rich profile of antioxidant compounds that act individually and synergistically to neutralize harmful free radicals, enhance the body's natural defense systems, and prevent cellular damage. Flavonoids serve as powerful antioxidants effectively scavenging

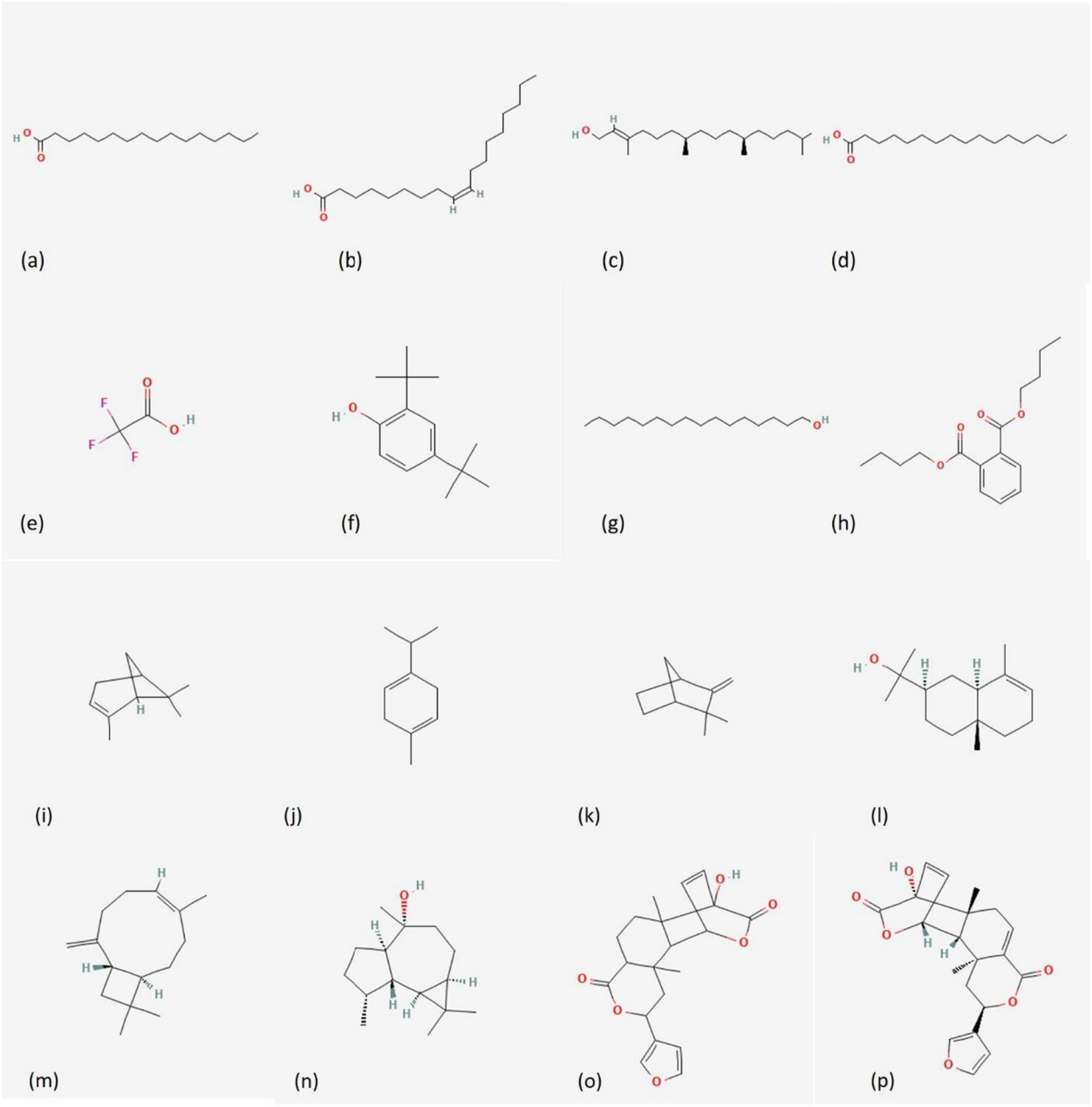

Fig. 2. Structure of some isolated compounds from *S. jollyanum*. a=n-Hexadecanoic acid; b= Oleic acid; c=Phytol; d= Hexadecanoic acid; e=Trifluoroacetic acid; f= 2,4-Di-tert-butylphenol; g=1-Hexadecanol; h=Dibutyl phthalate; i= α-pinene; j= γ-terpinene; k=camphene; l= α-eudesmol; m=isocaryophyllene; n=globulol; o=columbin; p=fibleucin.

reactive oxygen species (ROS) such as hydroxyl radicals and superoxide anions [38]. Their ability to inhibit lipid peroxidation helps maintain cellular membrane integrity, while their metal-chelating properties prevent the formation of damaging free radicals through Fenton reactions. These compounds are particularly effective in protecting delicate cellular structures from oxidative damage [39, 40]. The plant's alkaloid content contributes significantly to its antioxidant capacity. These compounds demonstrate strong radical scavenging activity against superoxide anions and hydrogen peroxide. Beyond direct neutralization of ROS, they activate the Nrf2 pathway, boosting the cell's intrinsic antioxidant response system and enhancing overall resistance to oxidative stress [41, 42]. Phenolic compounds, abundant in the stem bark and root extracts, play a crucial protective role through their ability to stabilize free radicals. By donating hydrogen atoms and transferring electrons, these molecules interrupt destructive radical chain

Table 1. Summary of Pharmacological Activities of Sphenocentrum jollyanum.

Activity	Plant Part Used	Type of Extract	Key Findings / Mechanisms	References
Antioxidant	Stem bark, leaf, root	Methanol, ethanol	Enhances SOD, CAT, GPx; reduces lipid peroxidation; strong DPPH scavenging	[7, 15, 16]
Anti-inflammatory	Leaf, fruit, root	Methanol, ethanol, aqueous	Inhibits cytokines (TNF-α, IL-6); stabilizes membranes; lipoxygenase inhibition	[17, 18]
Analgesic	Leaf	Ethanol	Reduces pain responses in mice models; comparable to acetylsalicylic acid	[19]
Wound Healing	Root, leaf, stem	Aqueous, ethanol	Stimulates VEGF, collagen deposition, and angiogenesis; reduces inflammation	[20, 21]
Antidiabetic	Root, seed	Aqueous, petroleum ether, methanol	Lowers blood glucose; inhibits α-amylase, α-glucosidase; antioxidant and insulin-like effects	[22–25]
Anti-ulcer	Whole plant	Methanol	Reduces gastric lesions; improves SOD, CAT levels; histological protection	[26]
Antimalarial	Leaf, root	Methanol, ethanol	Suppresses *Plasmodium berghei*; improves RBC and platelet count	[16, 27]
Antipyretic	Leaf	Methanol, petroleum ether	Reduces fever via NF-κB, COX-2 inhibition, and ROS scavenging	[28]
Aphrodisiac	Root	Ethanolic	Enhances libido and testosterone; biphasic dose-dependent effect	[29]
Anti-angiogenic	Stem bark	Methanol, chloroform fraction	Inhibits blood vessel formation in CAM assay	[7]
Hepatoprotective	Leaf, stem bark	Methanol, ethanol	Protects against APAP, CCl_4, and rifampicin-induced liver injury	[30, 31]
Antimicrobial	Root, leaf	Methanol, ethyl acetate	Effective against *Salmonella*, *Candida*, *Fusarium*; antiviral against polio Type 2	[32–35]
Anti-allergic	Fruit	Ethanol	Inhibits eosinophilia and leukocytosis; stabilizes membranes	[36]

reactions. Their comprehensive protection extends to vital cellular components including DNA strands, protein structures, and lipid membranes, preventing oxidative damage that could compromise cellular function [43, 44]. Terpenoids contribute to redox balance by enhancing mitochondrial antioxidant defenses, inhibiting ROS production through NADPH oxidase activity, and upregulating heme oxygenase-1 (HO-1). This multi-pronged approach helps protect against oxidative stress and its associated cellular damage [45].

7.2. Anti-inflammatory and analgesic properties

S. jollyanum exhibits significant anti-inflammatory properties. Methanol extracts from the fruit and root have shown substantial inhibition of inflammation in animal models, with the fruit extract demonstrating a 79.58% inhibition of inflammation in a carrageenan-induced rat model, outperforming the root extract. Isolated compounds such as columbin and flavonoid-rich fractions also showed significant anti-inflammatory effects comparable to acetylsalicylic acid [9]. The ethanol leaf extract has also been shown to reduce inflammation in various models, including carrageenan-induced paw oedema and xylene-induced ear oedema in mice. The extract's effects were dose-dependent and comparable to standard anti-inflammatory drugs like acetylsalicylic acid and dexamethasone [18]. In-vitro assays have further demonstrated that the aqueous and ethanol extracts of *S. jollyanum* leaves possess significant anti-inflammatory potential through mechanisms such as erythrocyte membrane stabilization and lipoxygenase and proteinase inhibition [17]. The plant's extracts have been shown to modulate pro-inflammatory cytokines and increase growth factor secretion, which may enhance wound healing and reduce inflammation [20]. Additionally, In vivo studies using ethanol leaf extract of *S. jollyanum* in albino mice demonstrated significant analgesic activity. The extract reduced pain in models such as acetic acid-induced abdominal writhing and formalin-induced paw licking. The effects were dose-dependent, with higher doses showing greater pain inhibition, comparable to standard drugs like acetylsalicylic acid and dexamethasone. The extract's analgesic effects are thought to be mediated through the inhibition of prostaglandin synthesis or peripheral pain inhibition mechanisms [19].

7.3. Wound healing properties

A study on diabetic rats demonstrated that aqueous extracts of *S. jollyanum* roots and leaves significantly enhanced wound healing. The extracts reduced

pro-inflammatory cytokines (TNF-α, IL-6), microbial colonization, and myeloperoxidase activity while increasing growth factor secretion. Histological evaluations showed mature tissue granulation, new blood vessels, collagen, and fibroblasts with fewer inflammatory cells [20]. The compound 1,4-polyisoprene, isolated from the stem, significantly improved wound closure and tissue regeneration, indicating its potential as a therapeutic agent for wound management [21]. The main active compounds in *S. jollyanum* responsible for wound healing include flavonoids, known for their anti-inflammatory and antioxidant properties that reduce oxidative stress and inflammation; alkaloids, which exhibit antimicrobial and anti-inflammatory effects, aiding infection prevention and tissue repair; terpenoids, particularly furanoditerpenes like columbin, isocolumbin, and fibleucin, with significant anti-inflammatory activity; phenolic compounds, contributing antioxidant effects to protect wound tissues; and saponins, which prevent microbial colonization due to their antimicrobial properties [2, 9, 20]. While not a phytochemical itself, the plant extracts stimulate VEGF secretion, promoting angiogenesis and the formation of new blood vessels essential for tissue regeneration [20]. These bioactive compounds collectively modulate pro-inflammatory cytokines (e.g., TNF-α and IL-6), reduce microbial colonization, enhance angiogenesis through VEGF stimulation, and improve collagen deposition and fibroblast proliferation, making *S. jollyanum* a potent therapeutic agent for wound healing in diabetic conditions.

7.4. Anti-diabetic and hypolipidemic effects

S. jollyanum has been studied for its anti-diabetic and hypolipidemic. The aqueous root extract of *S. jollyanum* has been shown to reduce blood glucose levels in alloxan-induced diabetic rabbits. The extract exhibited dose-dependent reductions, with significant effects observed from day 3 of treatment [23]. The extracts inhibit carbohydrate-metabolizing enzymes such as α-amylase and α-glucosidase, which are crucial for glucose absorption and metabolism. This inhibition helps in managing blood glucose levels [22]. The plant extracts possess antioxidant properties, which help mitigate oxidative stress associated with diabetes. This antioxidant activity supports the overall anti-diabetic effect by protecting pancreatic beta cells [22]. The methanolic extract significantly reduced blood glucose and serum lipid levels, supporting its traditional use in managing diabetes mellitus. These effects were comparable to those of glibenclamide, a standard antidiabetic drug [25]. The petroleum ether seed extract of *S. jollyanum* also demonstrated anti-diabetic activity by lowering blood glucose levels in a dose-dependent manner in alloxan-induced diabetic rabbits [24].

The specific compounds in *S. jollyanum* contributing to its antidiabetic properties include flavonoids, which exhibit antioxidant and anti-inflammatory effects that protect pancreatic beta cells from oxidative stress and enhance insulin sensitivity; terpenoids, known for their hypoglycemic activity in improving glucose uptake and tolerance, as evidenced by studies on the ethyl acetate root extract; saponins, which inhibit key carbohydrate-metabolizing enzymes like α-amylase and α-glucosidase, thereby reducing glucose absorption and regulating blood sugar levels; and phenolic compounds, which provide antioxidant protection against oxidative damage linked to diabetes [2, 23, 46]. Molecular docking studies suggest that furanoditerpenes like columbin and isocolumbin from *S. jollyanum* interact with the glucagon-like peptide-1 receptor (GLP-1R), which is a target for some antidiabetic drugs. This interaction could contribute to its antidiabetic effects, although further studies are needed to confirm this mechanism [47].

7.5. Anti-ulcer properties

S. jollyanum has demonstrated anti-ulcer properties, particularly in the context of indomethacin-induced gastric ulcers. The methanol extract of *S. jollyanum* at a dose of 200 mg/kg body weight reduced the gastric ulcer index significantly, indicating its effectiveness in protecting the gastric mucosa against indomethacin-induced ulcers [26]. The anti-ulcer activity is partly attributed to the antioxidant properties of the extract, which help mitigate oxidative stress and lipid peroxidation associated with gastric ulcers. The extracts increased antioxidant enzyme activities such as superoxide dismutase (SOD) and catalase (CAT), contributing to their gastroprotective effects [26]. Histological studies showed that *S. jollyanum* extracts reduced the severity of gastric lesions, promoting tissue repair and healing. This suggests that the extracts not only prevent ulcers but also facilitate the recovery of damaged gastric tissues [26]. Phytochemicals such as flavonoids, tannins, alkaloids, terpenoids, and saponins may help protect against ulcers through multiple mechanisms. These include reducing gastric acid secretion, strengthening the mucosal barrier, promoting mucin production, and enhancing antioxidant defenses. Additionally, they mitigate oxidative stress and inflammation in the gastric lining, increase mucosal prostaglandin levels, inhibit Helicobacter pylori growth, and may form protective coatings on the stomach mucosa [48].

7.6. Anti-malarial potential

The traditional utilization of *S. jollyanum* to treat malaria is supported by emerging scientific evidence of its anti-plasmodial activity. Methanol leaf and root extracts demonstrated 74.4% and 54.1% suppression of Plasmodium berghei in mice, respectively, though less potent than artemether-lumefantrine (81.4%) [16]. The ethanol root extract improved hemoglobin levels, red blood cell counts, and platelet function in malaria-infected mice, countering anemia and thrombocytopenia [27]. *S. jollyanum* exerts its antimalarial effects through multiple mechanisms of action, including enhancing immune responses by modulating immune cell activity and cytokine regulation [27]. Additionally, its antioxidant properties reduce oxidative stress by scavenging harmful free radicals and upregulating key antioxidant enzymes such as superoxide dismutase (SOD) and catalase (CAT) [15]. Certain bioactive compounds, including alkaloids and terpenoids, directly target parasites by disrupting their metabolic pathways and inhibiting replication [49]. While *S. jollyanum* extracts are less potent than conventional antimalarial drugs like chloroquine and artemisinin derivatives, they provide valuable complementary benefits. They help reduce complications such as anemia and inflammation, thereby supporting better recovery outcomes. Furthermore, preliminary studies indicate that these plant-derived compounds may have a more favorable safety profile compared to synthetic antimalarials, suggesting potential for reduced toxicity in therapeutic applications [50].

7.7. Antipyretic

S. jollyanum exhibits significant antipyretic activity, which has been validated through experimental studies. Methanol and petroleum ether extracts of the leaves have demonstrated antipyretic properties in vitro. These extracts were tested using standard models for fever induction, showing a reduction in elevated body temperature comparable to conventional antipyretic drugs [28]. The plant's bioactive compounds, including flavonoids, alkaloids, and terpenoids, act synergistically to modulate key molecular mechanisms associated with fever. Alkaloids suppress pro-inflammatory mediators by inhibiting NF-κB and MAPK signaling pathways, thereby reducing the production of cytokines (TNF-α, IL-6, and IL-1β) [51]. This inhibition attenuates fever-inducing prostaglandin E2 (PGE2) synthesis by downregulating cyclooxygenase-2 (COX-2) expression in the hypothalamus [52]. Oxidative stress exacerbates febrile responses by activating inflammatory cascades. Flavonoids scavenge reactive oxygen species (ROS) and upregulate endogenous antioxidants, including SOD and CAT, via activation of the Nrf2/ARE pathway [53]. Terpenoids further enhance this effect by stabilizing mitochondrial membranes, reducing ROS generation [54].

7.8. Reproductive and sexual activity

S. jollyanum has been studied for its effects on reproductive and sexual activity, particularly in male rodents, with findings that reveal both stimulatory and potentially harmful impacts. Ethanolic root extracts of *S. jollyanum* have been shown to stimulate sexual behavior in male mice and rats. This includes increased mounting frequency, intromission frequency, and prolonged ejaculation latency, alongside decreased mounting latency, intromission latency, and post-ejaculatory interval. These changes indicate enhanced libido and sexual performance [29]. The sexual stimulation appears to have a biphasic dose-response, with some parameters showing a U-shaped curve, meaning effects are prominent at moderate doses but diminish or disappear at higher doses. The immediate increase in sexual behavior is thought to be due to a central nervous system stimulatory effect, while the longer-term effects are likely related to increased testosterone levels [29]. Testosterone levels increased significantly, up to fourfold by the third week of treatment with the extract. Follicle-stimulating hormone (FSH) showed a transient increase by the second week but dropped by the third week. Luteinizing hormone (LH) levels decreased by the second week, and prolactin levels remained largely unchanged or showed variable changes depending on the study [29].

Despite the positive effects on sexual behavior and testosterone, methanol and ethanol extracts of *S. jollyanum* root have been reported to cause detrimental effects on sperm quality and reproductive function in male rats. These include a dose-dependent reduction in sperm motility, viability, and total sperm count, increased percentage of abnormal spermatozoa, and degeneration of testicular seminiferous tubules observed histologically. No significant changes in epididymal volume or white blood cell counts, but some hematological parameters like red blood cell count and hemoglobin increased [1, 55]. These adverse effects on sperm parameters suggest potential reproductive toxicity despite the steroidogenic effects of the plant.

7.9. Anti-angiogenic activity

S. jollyanum exhibits notable anti-angiogenic activity, primarily demonstrated using the chick

chorioallantoic membrane (CAM) assay, a standard method for assessing inhibition of new blood vessel formation. The methanol extract of the stem bark showed significant dose-dependent anti-angiogenic effects, with an activity score of 1.00 at 500 μg/pellet. Further fractionation revealed that the chloroform fraction was even more potent, with a score of 1.30 at 250 μg/pellet [7]. The anti-angiogenic effects are attributed mainly to the presence of flavonoids and alkaloids in the active fractions. Flavonoids are well-known for their ability to inhibit angiogenesis, and alkaloids isolated from the plant may also contribute to this activity by targeting signaling pathways involved in vascular endothelial growth factor (VEGF) expression and endothelial cell proliferation.[56, 57].

7.10. Hepatoprotective

S. jollyanum exhibits significant hepatoprotective activity, demonstrated in various experimental models of liver injury induced by toxic agents such as acetaminophen (APAP), carbon tetrachloride (CCl4), and rifampicin. Ethanolic extract of the stem bark of *S. jollyanum* showed protective effects against APAP-induced liver damage in rats. The extract ameliorated liver injury markers and promoted regenerative changes in liver tissue. This effect is attributed to the presence of phytochemicals like saponins, tannins, alkaloids, terpenes, and flavonoids, as well as antioxidant and anti-inflammatory activities of the extract [30]. The stem bark extract significantly increased antioxidant enzymes such as SOD, catalase, GPx, and glutathione S-transferase (GST), while reducing lipid peroxidation in CCl4-induced hepatotoxic rats. This antioxidant activity helps protect hepatocytic cell membranes and supports regeneration of damaged liver cells [37]. The methanol leaf extract demonstrated hepatoprotective effects against rifampicin-induced liver damage in Wistar albino rats. Treatment with the extract led to significant reductions in serum liver enzymes (AST, ALT, ALP) and total bilirubin, alongside increased total protein and albumin levels. The extract also enhanced antioxidant enzyme activities and decreased malondialdehyde (MDA) levels, indicating reduced oxidative stress. Histological analysis confirmed reduced liver necrosis and inflammation in treated groups [31].

7.11. Antimicrobial activities

S. jollyanum exhibits broad-spectrum antimicrobial activities, including antibacterial, antifungal, and antiviral effects, supported by scientific studies. The root extract shows activity against bacterial strains such as Salmonella typhi [58]. The methanolic leaf extract and ethyl acetate fraction of the root extract demonstrate strong antifungal activity against Candida albicans and various Fusarium species isolated from human and plant sources [32, 35]. In vitro studies report minimum inhibitory concentrations (MIC) as low as 12.5 mg/mL for Candida albicans and even lower MIC values (0.0679 μg/mL) against Fusarium isolates, indicating potent antifungal effects [35]. Formulated ointments from the ethyl acetate fraction of the root extract significantly reduced fungal loads in infected animal models, validating traditional use in treating chronic wounds and fungal infections [32]. Phytoecdysteroidal glycosides isolated from *S. jollyanum* has shown activity against Aspergillus fumigatus Pinh and Vancomycin resistant enterococcus. The ethyl acetate fraction showed activity against A. fumigatus (IC50 $<$ 8μg/mL) [10]. The antifungal potency of *S. jollyanum* leaf extract often exceeds that of conventional antifungal drugs such as fluconazole and miconazole in laboratory tests [35]. Although less extensively documented, *S. jollyanum* extracts have demonstrated antiviral properties, attributed to its rich phytochemical profile including alkaloids, flavonoids, saponins, and terpenoids [33]. The methanol extracts of the different morphological parts were assessed for their antiviral activities on polio virus Types 1, 2, and 3. It was observed from the study that the leaf and root extracts were active against polio virus Type 2 [34].

The antimicrobial mechanisms of saponins, flavonoids, tannins, and terpenoids involve distinct but sometimes overlapping biochemical interactions with microbial cells. Saponins primarily disrupt microbial cell membranes by binding to membrane lipids, increasing permeability, and causing leakage of vital intracellular components, which leads to cell lysis [59, 60]. They also enhance antibiotic effectiveness and stimulate host immune responses [61]. Flavonoids inhibit microbial growth by damaging membranes, interfering with nucleic acid synthesis, chelating essential metal ions, generating reactive oxygen species, and preventing biofilm formation, thereby disrupting multiple cellular processes [40]. Tannins exert antimicrobial effects mainly by precipitating microbial proteins, including enzymes and cell wall components, which impairs microbial metabolism and damages cell structures. They also chelate metal ions, depriving microbes of nutrients necessary for survival [62]. Terpenoids disrupt microbial membranes by inserting into lipid bilayers, increasing membrane fluidity and permeability, and interfere with microbial respiration and quorum sensing, reducing virulence and energy production [63].

Table 2. Summary of toxicological and safety studies on *S. jollyanum*.

Parameter	Type of Extract/Part Used	Dosage Range	Animal Model	Observed Effects	Reference
Acute toxicity (oral)	Ethanolic leaf extract	Up to 11,000 mg/kg	Wistar rats	No mortality or behavioral changes; safe at high oral doses	[67]
Acute toxicity (i.p.)	Ethanolic leaf extract	$LD_{50} \approx$ 1,445.4 mg/kg	Wistar rats	Lethal at lower doses via i.p. route; suggests route-dependent toxicity	[67]
Sub-chronic toxicity (120 days)	Ethanolic leaf extract	250–750 mg/kg/day	Wistar rats	↑ RBC, PCV, hemoglobin; no liver or kidney damage	[68]
Reproductive toxicity	Root extract	250–500 mg/kg/day	Male albino rats	↓ Sperm motility/count; seminiferous tubule degeneration; effects reversible	[1]
Hematological activity	Seed oil	400 mg/kg/day	Wistar rats	Significant increase in hematological parameters (RBC, Hb, PCV)	[68]
Histopathological changes	Root extract	500 mg/kg/day	Male albino rats	Testicular degeneration observed in high-dose group	[1]

7.12. Anti-allergy activities

S. jollyanum exhibits significant anti-allergy activity, primarily demonstrated by its fruit ethanol extract in experimental models. The extract showed dose-dependent inhibition of milk-induced eosinophilia and leukocytosis in mice, reducing elevated eosinophil and lymphocyte counts close to normal levels, comparable to the standard anti-allergic drug dexamethasone [36]. This anti-allergic effect is linked to the extract's strong anti-inflammatory properties, including erythrocyte membrane stabilization, trypsin inhibition, and lipoxygenase inhibition, which help prevent the release of chemical mediators involved in allergic reactions. Among the secondary metabolites, saponins demonstrated the highest anti-inflammatory activity, while tannins likely play a dominant role in membrane stabilization. The anti-allergy effect likely involves multiple mechanisms due to interactions among the phytochemicals present in the fruit extract [36]. The anti-allergy potential of *S. jollyanum* is attributed to its rich phytochemical content, especially saponins, tannins, flavonoids, and alkaloids. Saponins possess mast cell stabilizing activity, preventing the release of histamine and other allergy mediators [64]. Flavonoids contribute through anti-histamine activity, smooth muscle relaxation, and bronchodilation, while tannins aid in membrane stabilization [65, 66].

8. Toxicological and safety profile

Acute toxicity studies indicate that oral administration of *S. jollyanum* leaf extract up to 11 g/kg body weight does not produce toxicity in animal models (Table 2). However, intraperitoneal administration yields a median lethal dose (LD_{50}) of approximately 1,445.4 mg/kg, suggesting route-dependent toxicity [67]. Sub-chronic toxicity evaluations over 120 days reveal no mortality or significant organ damage. Notably, treated animals exhibit increased red blood cell counts, packed cell volume, and hemoglobin concentrations, indicating potential hematinic properties. Liver and kidney function tests remain within normal ranges, underscoring the extract's relative safety upon prolonged oral administration [68]. Genotoxicity assessments using Salmonella typhimurium strains (TA97, TA98, TA100, and TA102) show no mutagenic effects of *S. jollyanum* root extract. However, the extract induces cytochrome P450 enzymes, which could alter the metabolism of concomitantly administered drugs, highlighting the need for caution regarding potential drug-herb interactions.

9. Challenges and future directions

Despite the increasing scientific interest in *S. jollyanum*, several challenges continue to limit its full pharmacological exploitation and clinical translation. One of the foremost limitations is the scarcity of clinical evidence. The majority of available data on *S. jollyanum* stems from in vitro assays and in vivo animal models, with little to no human studies published to date. This lack of clinical trials undermines the generalizability of its therapeutic benefits to human populations and restricts its potential for regulatory approval and inclusion in formal treatment guidelines. Another critical issue is the lack of standardization in extract preparation and phytochemical profiling. Different studies have employed various plant parts—roots, leaves, stem bark, and seeds—alongside diverse extraction solvents and dosages, leading to considerable heterogeneity in outcomes.

For instance, both aqueous and methanolic extracts of the root have shown antidiabetic properties, but their phytochemical profiles differ significantly in terms of alkaloid and flavonoid content [3, 22]. Without standardized protocols for extract preparation, it becomes difficult to reproduce and compare findings across studies, a challenge that hampers drug development efforts.

Additionally, the pharmacodynamic and molecular mechanisms underlying many of *S. jollyanum*'s reported bioactivities remain poorly understood. While the plant has demonstrated antioxidant, anti-inflammatory, and antimicrobial effects, detailed molecular studies are lacking. For example, compounds such as columbin and isocolumbin have been linked to antidiabetic effects through potential GLP-1 receptor activation, yet this interaction is only supported by preliminary docking studies and awaits empirical validation [47]. The absence of omics-based approaches (e.g., transcriptomics, proteomics, metabolomics) and receptor-binding assays limits our understanding of the pathways modulated by the plant's diverse bioactive constituents.

Safety concerns, particularly regarding long-term use and reproductive toxicity, present another challenge. Although acute and sub-chronic toxicity studies have shown that high oral doses are relatively safe in rodents [67], reports of sperm degeneration and reduced fertility parameters following chronic use raise red flags for potential reproductive toxicity [1]. Looking forward, several strategies should be prioritized to harness the therapeutic potential of *S. jollyanum*. First, well-structured clinical trials are urgently needed to validate its safety, efficacy, and pharmacokinetics in human subjects. Second, standardized protocols for cultivation, harvesting, and extract preparation should be developed in accordance with Good Agricultural and Collection Practices (GACP) and Good Manufacturing Practices (GMP). These standards will ensure consistent phytochemical quality and reproducibility of therapeutic effects. Mechanistic studies using systems biology approaches such as molecular docking, high-throughput screening, and pathway enrichment analysis should be employed to identify bioactive targets and elucidate the cellular mechanisms of action. In parallel, pharmacokinetic and pharmacodynamic studies are necessary to evaluate absorption, distribution, metabolism, and excretion (ADME) profiles, as well as drug–herb interaction risks. Additionally, conservation efforts should be promoted through community-based cultivation and ex situ preservation of germplasm to prevent overexploitation of wild populations. Lastly, novel drug delivery systems—including nanoparticles, transdermal patches, and controlled-release formulations—could be explored to improve the bioavailability and therapeutic efficacy of *S. jollyanum*-based preparations. Integrating these multidisciplinary approaches will be essential to position *S. jollyanum* as a viable candidate in the global pharmacopeia and to support its transition from traditional use to scientifically validated therapeutics.

10. Conclusion

S. jollyanum is a pharmacologically versatile plant with a rich ethnomedicinal heritage across West Africa. Its broad spectrum of therapeutic effects can be attributed to its diverse phytochemical composition. While these bioactivities provide compelling justification for its continued exploration in drug development, a critical assessment of its toxicological profile is necessary for responsible clinical application. Evidence from acute and sub-chronic toxicity studies suggests that *S. jollyanum* possesses a high margin of safety when administered orally, with no significant damage observed in hepatic or renal tissues at therapeutic doses. However, notable adverse effects such as reduced sperm quality and testicular degeneration following prolonged use highlight potential reproductive toxicity risks that warrant further investigation.

Despite its promising pharmacological potential, *S. jollyanum* remains largely underutilized in evidence-based medicine due to the paucity of clinical trials, inconsistent extract standardization, and incomplete mechanistic understanding. Bridging these gaps requires an integrated research approach encompassing pharmacokinetics, clinical toxicology, formulation science, and sustainable harvesting practices to position *S. jollyanum* as a novel, plant-based therapeutic agent with applications across multiple disease domains, ultimately contributing to the global compendium of validated herbal medicines.

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Ethical statement

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Data availability statement

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Conflicts of interest

The author declares that there is no conflict of interest.

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