REVIEW ARTICLE

Cyperus articulatus L.: A Review on Phytochemical & Pharmacological Exploration, and Effects on Human Health

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Received: 16th November, 2023; Revised: 10th December, 2023; Accepted: 04th January, 2024; Available Online: 25th March, 2024

ABSTRACT

Cyperus articulatus L., a member of the Cyperaceae family, is distinguished by delicate blooms at its tips. Traditionally used in northern Brazilian spas and artisanal colonies, the tubers sliced from the plant's stalks emit a refreshing, woodsy, and spicy aroma. Beyond its aesthetic and aromatic appeal, the plant boasts significant medicinal and pharmacological benefits. Pharmacologically, it exhibits properties such as antimalarial, sedative, hepatoprotective, central nervous system (CNS) contraceptive, insecticidal, antibiotic, anticancer, antioxidant, anticonvulsant, and anthococcosis medication. For instance, the chloroform extract of priprioca rhizomes revealed antimalarial metabolites, including "cyperotundone, alpha-cyperone, and mustacone." The "*C. articulatus* rhizome decoction" contained sedative sugars, flavonoids, saponins, triterpenes, and polyuronides. Notably, the study did not detect metabolites related to hepatoprotection, contraception, and the central nervous system. Insecticidal activities were linked to the aromatic compounds, mono and sesquiterpenes, of the rhizome methanolic extract. Antibacterial activity, attributed to compounds and pinene, was found in ethanolic and chloroform extracts of rhizomes. The essential oil from *C. articulatus* exhibited anticancer effects, featuring sesquiterpenes and monoterpenes. Phenolic chemicals in the essential oil were associated with antioxidant capabilities. Alkaloid chemicals in *C. articulatus* rhizome extract demonstrated anticonvulsant action, along with the presence of linoleic acid and mustakone metabolites. This study comprehensively explores the medicinal, therapeutic, and pharmacological benefits of *C. articulatus*.

Keywords: *Cyperus articulatus*, Medical and therapeutic activity, Priprioca, Pharmacological properties, Cyperaceae, Medicinal properties.

International Journal of Pharmaceutical Quality Assurance (2024); DOI: 10.25258/ijpqa.15.1.72

How to cite this article: Dhar S, Datta S, Yadav A. *Cyperus articulatus* L.: A Review on Phytochemical & Pharmacological Exploration, and Effects on Human Health. International Journal of Pharmaceutical Quality Assurance. 2024;15(1):466-474.

Source of support: Nil.

Conflict of interest: None

INTRODUCTION

Plant-derived materials serve a vital part in the broad landscape of the global pharmaceutical business.[1] These materials provide a wide variety of uses, ranging from time-honored traditional medicines to natural cures and cosmetic items.[2] Certain species of the Cyperaceae family emerge as essential contributions to regional pharmacopeias, notably addressing problems such as contraception, pain reduction, and diarrhea treatment. This diversified botanical reservoir is home to a large number of medicinal plants.[3]

In this investigation, we focus on *Cyperus articulatus* L., often known as the tall grass that grows along the sides of rivers and tropical streams. In common parlance, this plant is referred to as the tall grass.[4] This plant, which is known in the scientific community as the priprioca plant and belongs to the family Cyperaceae, seems to be modest; nonetheless, it reveals distinctive characteristics that make it the topic of major research.[5] In spite of its unassuming appearance, which is distinguished by flowers that are few in number and nearly undetectable at the plant's tips, *C. articulatus* has carved out a special niche for itself in the northern region of Brazil, particularly in the state of Pará, due to its exceptional aromatic capabilities.[6] The fresh, woodsy, and spicy perfume is produced by the small rhizomes that are developed from the stalks of the plant. These rhizomes contribute to aromatherapy treatments and feature heavily in the artisanal workmanship of local colonies.[7]

C. articulatus stands out as a notable member of the broad Cyperaceae family because it is botanically placed under the genus *Cyperus*, is a member of the order Cyperales, and is a member of the class Liliopsida. The Cyperaceae family is notable because it is the third-largest monocotyledon family. It has 104 genera and 5,000 species, making it the third-largest family overall.[8]

This investigation will make an effort to delve into the pharmacological complexities of *C. articulatus*. The

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overarching goal of this research is to contribute to a more nuanced understanding of the therapeutic potential inherent in plant species, with a particular emphasis on those belonging to the family Cyperaceae.[9] This study attempts to shed light on the larger storey of the delicate interaction between botanical resources and human well-being by unraveling the varied contributions of *C. articulatus* to both local practices and global pharmacology.[10]

Using Google Scholar, Scielo, and CAPES, a complete overview of the pharmacological and therapeutic properties of *C. articulatus* was uncovered using a literature review technique. The selection was narrowed down using explicit inclusion and exclusion criteria, guaranteeing both relevance and reliability. Searches using Boolean operators and keywords improved specificity, and thorough evaluation of the best sources, with an eye on such things as publication quality and author credibility, led to a more nuanced synthesis of the data. This systematic strategy is meant to provide a solid groundwork for investigating *C. articulatus's* medicinal potential.

Data extraction from the chosen literature was painstaking, with special attention paid to the aims and methods of the studies and the reported pharmacological effects. Information was synthesized and critically analyzed to reveal trends and areas of agreement that would guide the subsequent debate and findings. The survey's cohesiveness and intellectual integrity were guaranteed by the use of citation management software to ensure uniform and understandable reference throughout.

Phyto-chemical Constituents

Piri piri (*C. articulatus*) has a high concentration of beneficial chemicals, as shown by a phytochemical investigation.[11] Alkaloids, flavonoids, polyphenols, saponins, tannins, and terpenes are all found in high concentrations in the grass, to name just a few. Among the separated compounds, cyperotundone and alpha-corymbolol stand out as particularly promising candidates for further study. Other notable substances include alpha-cyperone, alpha-pinene, carophyllene oxide, corymbolone, and mustakone. These chemicals have been hypothesized to have antimalarial properties and work in a manner similar to that of commonly used analgesics like aspirin and ibuprofen.[12]

Cyperus plants, such as piri piri, provide essential oils rich in sesquiterpenes, with cyperene serving as the primary hydrocarbon. Carophyllene, eudesmane, patchouli oil, and rotundone are some of the other sesquiterpenes found in the plant. Articularone, a sesquiterpene ketone discovered in *Cyperus corymbosus* (syn. *C. articulatus*), shares chemical characteristics with cyperone. Compounds like cyperotundone and alpha-cyperone exhibit the ability to suppress nitric oxide formation, suggesting potential antioxidant properties and antimalarial effects.[13]

Furthermore, terpene compounds found in piri piri, such as alpha-pinene, alpha-corymbolol, carophyllene oxide, iso-patchoul-4(5)-en-3-one, corymbolone, mandaside, and mustakone, showcase the diversity of its chemical profile.[14] Qualitative and quantitative variations exist between oils of

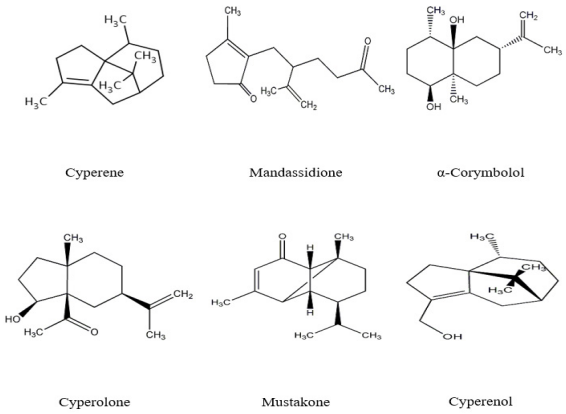

Figure 1: Molecular structural profile of some important compounds from *Cyperus articulates*[16]

different kinds; for instance, the red-type oil demonstrates higher concentrations of cyperotundone, maaline, piperitone, germacrone, 1-epicubenol, pinene, and cyperene epoxide. In contrast, the black-type oil is characterized by components like cedrol, guaia-5-en-11-ol, -pinene, sabinene, trans-pinocarveol, trans-carveol, cis-carveol, and –cardinol. This intricate phytochemical profile underscores the potential therapeutic significance of piri piri in various applications (Figure 1).[15]

Medicinal and Therapeutic Properties

C. articulatus, commonly known as piri piri, boasts a myriad of medicinal and therapeutic properties.[17] The herb exhibits sedative qualities and carminative effects, aiding in reducing gas and potentially inducing miscarriage. It serves as a versatile remedy, functioning as a pain reliever, contraceptive, anti-inflammatory agent, regulator of ovulation, and migraine alleviator. Additionally, pregnant women find relief from morning sickness through its use.[18]

In indigenous Mexican communities, piri piri plays a significant role in addressing "culture-connected disorders," particularly those rooted in ancient indigenous beliefs that may not easily align with Western medical paradigms. Symptoms vary widely, encompassing discomforts such as fear, embarrassment, exhaustion, gastrointestinal distress, and flatulence (Table 1).[19]

The herb's therapeutic applications extend to the treatment of conditions like rheumatism, arthritis, fractures, contusions, and twisting. Its underground components have been historically employed for diaphoretic and stimulating properties, effectively addressing ailments such as malaria, toothaches, headaches, and epilepsy.[20] When prepared as a decoction, rhizomes demonstrate efficacy against various conditions, including stomach aches, constipation, and respiratory infections. Moreover, the powdered herb serves as a topical friction rub for issues like libido, headaches, rheumatism, edema, and ovulation problems. Migraine sufferers may also benefit from inhaling the dry powder.[21]

Indigenous populations, such as the 'Tiriyó and Yanomami' Indians in Brazil and the Ecuadorian and Peruvian Amazon inhabitants, utilize piri piri infusion to treat fever through

Table 1: Medicinal and therapeutic properties of *C. articulatus* [25]

Property	*Activity*	*Related metabolites*	*Part used*
Anti-malaria	Plasmodial features, activity against drug-resistant forms of *P. falciparum*	Sesquiterpenes (*Corimbolones, Mustacones*)	Rhizomes
Sedative	Sedative properties dampens motor activity	Flavonoids, sugars, triterpenes, saponins, polyuronides	Rhizomes
Hepatoprotective	Hepatoprotective effects	Not specified	Rhizomes
Contraceptive	Influences reproductive hormones, increases LH	Not specified	Aqueous extract of rhizomes
Central nervous system effects	Sedative effects on CNS, potential anti-epileptic activity	Not specified	Rhizome decoction
Insecticidal	Repels beetle *Tribolium casteneum* Herbs	Terpenoid compounds	Rhizomes (Methanolic Extract)
Antimicrobial	Strong antibacterial effects	Essential oil, bioactive components, inhibition of AMPC enzyme	Decoction, essential oil
Anticancer	Cytotoxic effects on cancer cells	Essential oil, chitosan-encapsulated nanoparticles, mustakona, linoleic acid	Essential oil, rhizomes (Chitosan Nanoparticles)
Antioxidant	Antioxidant properties	Phenolic substances, essential oils, free radical scavenging	Essential oil
Anticonvulsant	Anti-epileptic activity, potential GABA interaction	Not specified	Rhizome extract, leaf extract
Anti-onchocercal	Anti-filarial activity against *O. ochengi*	Mustakona (AMJ1), linoleic acid	Rhizomes

ingestion or topical application. Various medicinal practices, such as scrubbing noses to alleviate snoring habits, have been observed among different cultures.[22]

Different preparations, including an alcoholic solution and an infusion, are utilized for diverse therapeutic purposes, ranging from diaphoresis and stimulation to addressing bladder and gastralgia issues.[23] Piri piri, with its rich curative history, remains a valuable component in traditional medicine for its multifaceted applications. Rural residents employ the aqueous extract of its rhizomes to address gastrointestinal problems and enhance overall well-being.[24]

Pharmacological Properties

Anti-malaria and sedative properties of C. articulatus

C. articulatus boasts significant medicinal properties, particularly in terms of its antimalarial and sedative attributes, which are attributed to its diverse chemical composition. The plant's chemical foundation includes flavonoids, saponins, polyphenols, terpenes, tannins, and sugars.[26,27]

Among its constituents are sesquiterpenes, collectively known as cigerone. Notably, the sesquiterpene articulone ketone in rhizomes shares structural similarities with ciperone from peppermint. Compounds like cyperotundone and alpha-ciperone are purported to hinder nitric oxide production, a known pro-oxidant.[28]

Further, the sesquiterpenes corimbolones and mustacones, extracted from *C. articulatus* rhizomes, exhibit robust plasmodial features. Mustacone, in particular, demonstrates approximately tenfold higher activity against drug-resistant *Plasmodium falciparum* compared to corimbolone.[29]

In the realm of sedative properties, a decoction derived from *C. articulatus* rhizomes induces sedation in rat models. However, the entire rhizome extract does not exhibit anesthetic or paralytic effects but significantly diminishes spontaneous motor activity. Pharmacological metabolites such as flavonoids, saponins, sugars, triterpenes, and polyuronides contribute to its sedative-like effects, as outlined in (Table 2).

C. articulatus's antimalarial and sedative characteristics emanate from its intricate chemical composition, housing various bioactive compounds. The plant stands as a promising subject for further exploration in natural medicine, showcasing potential therapeutic benefits.

Hepatoprotective potential of C. articulatus

The study conducted by Datta *et al.* in 2013 delves into the methanolic extract of *C. articulatus* rhizomes, shedding light on its potential hepatoprotective effect (refer to Table 2). In their research, the methanolic extract exhibited promising outcomes when tested on rat subjects that had undergone paracetamol poisoning.[30]

Upon close examination of the cellular structure of the affected rats, it was evident that the methanolic extract played a crucial role in maintaining the normal architecture of the cells. This was notably distinct from the control group, where paracetamol poisoning had led to structural disruptions. The findings suggest a hepatoprotective attribute associated with the methanolic extract of *C. articulatus* rhizomes, showcasing its potential significance in mitigating the adverse effects of paracetamol-induced toxicity in the liver.[30]

Contraceptive attributes of C. articulatus

In various traditional cultures, *C. articulatus*, commonly known as privioca, has been employed as a contraceptive method. It's crucial to note that while this traditional application exists, there is a lack of scientific studies substantiating its efficacy. Consequently, women actively seeking conception are advised to exercise caution and refrain from using this herb.[31]

Table 2: Pharmacological properties of *C. articulatus*[81]

Property	*Description*
Anti-malaria	Plasmodial features, activity against drug-resistant forms of *P. falciparum*. Sesquiterpenes (Corimbolones, Mustacones) extracted from rhizomes have demonstrated significant antimalarial properties.
Sedative	Rhizome decoction exhibits sedative properties in rats, dampening spontaneous motor activity. Various metabolites contribute to these sedative-like effects, including flavonoids, saponins, sugars, triterpenes, and polyuronides.
Hepatoprotective	Methanolic extract of rhizomes shows hepatoprotective effects. It helps maintain the normal cellular structure of the liver, particularly after paracetamol poisoning in rats.
Contraceptive	Aqueous extract of rhizomes influences reproductive hormones, specifically increasing luteinizing hormone (LH), a hormone controlling ovarian function. Caution is advised for women attempting to conceive due to its potential contraceptive effects.
Central nervous system	Rhizome decoction has a sedative effect on the CNS. Potential anti-epileptic activity is attributed to an interaction with the NMDA receptor complex. It may influence GABA and protect against brain-generated lipid peroxidation.
Insecticidal	Methanolic extract of rhizomes repels the beetle *Tribolium casteneum* Herbst. Terpenoid compounds in the Cyperaceae family contribute to its insecticidal effects.
Antimicrobial	Decoction suppresses *Staphylococcus aureus* and *Pseudomonas aeruginosa* growth. It demonstrates strong antibacterial effects against antibiotic-resistant bacteria, and essential oil inhibits *Candida albicans* biofilm growth.
Anticancer	Essential oil, chitosan-encapsulated nanoparticles, and specific metabolites (Mustakona, Linoleic acid) show cytotoxic effects on cancer cells. *C. articulatus* holds potential for novel antifilarial medications.
Antioxidant	Essential oil exhibits antioxidant properties, scavenging free radicals. The plant's secondary metabolites, including phenolic substances, contribute to antioxidant effects.
Anticonvulsant	Rhizome extract and leaf extract show anti-epileptic activity. Potential interaction with GABA and protection against brain-generated lipid peroxidation are suggested mechanisms.
Anti-onchocercal	Hexane-extracted essential oil exhibits anti-filarial activity against *O. ochengi*, demonstrating dose-dependent effects on microfilariae and adult worms. The metabolites mustakona and linoleic acid contribute to its anti-onchocercal properties.

The multifaceted applications of *C. articulatus* extend beyond contraception, encompassing abortifacient and labor-inducing properties, among others. Exploring the impact on hormones governing ovarian reproduction, specifically follicle-stimulating hormones and luteinizing hormones, researchers conducted tests using an aqueous extract of *C. articulatus* rhizome in rats. These hormones play a pivotal role in ovarian reproduction.[32,33] The study revealed elevated levels of luteinizing hormone (LH), a key regulator of ovarian function, upon administration of the plant extract. As a precautionary measure, women desiring conception are advised to approach the use of these herbs with utmost care (refer to Table 2).[34]

The extensive array of medicinal properties associated with *C. articulatus*, ranging from abortive and anticonvulsant to stomachic and tonic, has contributed to its widespread utilization in Peru.[35]

Impact on the central nervous system

The administration of powdered rhizome, prepared by boiling in water for 30 minutes, has been a therapeutic approach for patients grappling with epilepsy.[36] *C. articulatus* exhibits efficacy in addressing various neurological disorders. Investigations have been conducted to validate the plant's interaction with the central nervous system (CNS). The rhizome decoction has demonstrated a sedative effect on the CNS. Research by Ngo Bum *et al.* (1996)[17] suggests that the anti-epileptic activity of *C. articulatus* may be attributed to interactions between rhizome components and the NMDA receptor complex, a significant contributor to the development and propagation of epileptiform activity. Animal studies with rhizome extract have revealed anti-convulsive effects, indicating its potential in epilepsy treatment. Further exploration is warranted to confirm the hypothesis that these effects could be linked to the anti-convulsive actions of NMDA receptor antagonists *in-vivo*.[37]

Contrary to the findings of Rakotonirina *et al.* (2001)[14], who confirmed sedative-like qualities in a rhizome extract of *C. articulatus*, the extract exhibited no analgesic or paralyzing effects. The extract notably reduced spontaneous movement in mice. The plant extract facilitated sleep induction and prolonged sleep duration without providing pain relief when combined with thiopental sodium or diazepam. Notably, there was no indication that the plant extract possessed muscle-relaxing effects compared to diazepam.[38]

Ngo Bum *et al.* reported widespread utilization of "*C. articulatus* L. (Cyperaceae) rhizome" extracts for treating diverse ailments in Africa and the Amazon, owing to the plant's sedative and anticonvulsant effects. Through electrophysiological testing on Xenopus oocytes expressing receptors, researchers unveiled the mechanism by which *C. articulatus* extracts exert their effects. The rhizomes were found to contain chemicals acting as agonists for GABA-B receptors and antagonists for NMDA receptors, thereby enhancing the inhibition of nervous system activity. These pharmacological characteristics affirm the plant's influence on the nervous system and validate its traditional medicinal usage. Ongoing efforts in our laboratory aim to quantify the active chemicals involved precisely.[39]

Insecticidal Properties

C. articulatus has been a natural pest control solution in Nigerian communities for generations. Research conducted

by Abubakar *et al.* (2000)[40] revealed the efficacy of the rhizome's methanolic extract in repelling the beetle *Tribolium casteneum* Herbst. The presence of terpenoid compounds in the Cyperaceae family, to which *C. articulatus* belongs, has been associated with insecticidal effects, as demonstrated in related studies on *Cyperus rotundus*.

Antimicrobial Properties

The decoction of *C. articulatus*, as demonstrated by Mongelli *et al.*[41], exhibited potent antimicrobial activity by fully suppressing the growth of *Staphylococcus aureus* and *Pseudomonas aeruginosa*. Yusuf *et al.*[42] emphasized the strong antibacterial effect of *C. articulatus* against antibiotic-resistant strains of *Escherichia coli, Klebsiella pneumoniae*, and *Proteus mirabilis*, targeting the production of the AMPC enzyme across all concentrations. Additionally, Bersan (2012)[43] noted a 28.08% reduction in biofilm growth attributed to *Candida albicans*, highlighting the anti-Candida efficacy of *C. articulatus* essential oils.[44]

The essential oil derived from *C. articulatus*, enriched with - and -pinene, exhibited inhibitory effects on *C. albicans* biofilm formation on polystyrene surfaces. Martins *et al.,* further explored the antibacterial properties of *C. articulatus*, noting its effectiveness against methicillin-resistant *S. aureus* and various gram-positive and gram-negative bacteria. The antibacterial activity of *C. articulatus* established its potential to resist bacterial development under certain circumstance*s* extracts against *S. aureus* at 333 K - 25 MPa and *Cladosporium sphaerospermum* at 333 K and 13 MPa.[45]

Anticancer Properties

C. articulatus, a medicinal plant with a historical medicinal usage dating back millennia,[46] has exhibited diverse pharmacological properties, including antimicrobial effects against *E. coli, Klebsiella pneumonia, Haemophilus influenzae, S. aureus, B. cereus*, and *Streptococcus pyogenes*. Researchers have found antimalarial and anti-inflammatory effects in the oil extracted from the plant.[47] Due to its biodegradability, biocompatibility, and safety, chitosan, a natural polysaccharide extracted from crab shells, has attracted interest as a nanoencapsulation material.[48]

Essential oils, such as those from *C. articulatus*, may be safely encapsulated in chitosan due to its unique qualities, such as its resilience at severe temperatures and acidic conditions.[49,50] Although chitosan nanoparticles have the ability to transport bioactive chemicals like *C. articulatus* essential oils to particular target locations, there is currently insufficient evidence to support this claim.[50]

Chemical profiles of *Cyperus* plants were found to vary little across species and nations, according to research by Andrade *et al.*[51] The primary bioactive components of *Cyperus* essential oils are oxygenated hydrocarbon derivatives, notably sesquiterpenes and monoterpenes.[52] Notably, *C. articulatus* extract at a concentration of 350 g/mL had cytotoxic effects on cancer cells, as reported by Kavaz, Idris, and Onyebuchi (2019).[53] Furthermore, the encapsulation of *C. articulatus* in chitosan nanoparticles increased its cytotoxicity against MDAMB-231 breast cancer cells after 40 hours *in-vitro*, indicating its potential as a candidate for further exploration in cancer treatment.[53]

Antioxidant Properties

Antioxidants play a crucial role in mitigating the effects of oxygen radicals produced during various physiological processes or environmental occurrences, thereby reducing oxidation rates.[54] Their main function involves inhibiting oxidation through mechanisms like reactive oxygen species blockade and metal ion complexation.[55] Nature encompasses two primary sources of free radicals, both capable of inducing oxidative stress.[56]

Increasingly popular in the food, beauty, and health industries, antioxidant compounds are sought after as alternatives to synthetic antioxidants associated with cancer risks.[57,58] Researchers are focusing on natural antioxidants in plant extracts, particularly those derived from aromatic and medicinal plants.[59] Phenolic substances, categorized as antioxidant secondary metabolites, play a crucial role in preventing the generation of harmful free radicals.[60,61] Essential oils and their components, renowned for their beneficial effects like antioxidant properties, have gained significant traction.[62]

Addressing the variability in the kinetics of chemical oxidation, Halvorsen *et al.*[63] emphasized that the response often lasts longer than conventionally suggested. The intricate dynamics of many compounds lead to their reaching ultimate states over hours or days, with some more resilient compounds not achieving a stable state within a reasonable timeframe.[64]

In a study by Kavaz *et al.,* the free antioxidant activity of *C. articulatus* essential oil coated with chitosan nanoparticles was compared to that of uncoated oil. The results revealed that the essential oil from *C. articulatus* exhibited superior free radical scavenging abilities compared to both chitosan nanoparticles and essential oil coated with chitosan nanoparticles.[65]

Anticonvulsant Properties

Epilepsy, characterized by frequent seizures and associated manifestations, is linked to brain oxidative stress caused by reactive oxygen species.[66] A global public health concern, epilepsy affects over 50 million people worldwide, cutting across ages, genders, and economic statuses. Industrialized countries report epilepsy rates of 50 out of every 100,000 persons while developing countries often face rates of one thousand per one hundred thousand.[67]

The International League for the Elimination of Epilepsy (ILAE) defines epilepsy as one or more seizures. Traditional pharmaceutical options for epilepsy come with potentially lethal side effects, including ischemia, liver damage, cognitive impairments, and mobility limitations.[68] Moreover, 20 to 30% of individuals remain resistant to treatment with artificial medications. Given these concerns, exploring alternative treatments rooted in natural medicine is crucial.

C. articulatus (Cyperaceae), known as "piri-piri" in Peru, is a rhizome plant endemic to Africa, Latin America, Asia, and Oceania. Decoctions from its rhizome are commonly used

in various regions, such as Cameroon, the Central African Republic, Gabon, Senegal, and the Amazon, to address headaches and migraines.[69]

While studies on the anticonvulsant effects of *C. articulatus* are limited, Herrera-Calderon *et al.*[70] proposed investigating the plant's leaves for potential anticonvulsant properties. Inducing seizures in mice with pentylenetetrazole, the study examined GABA and MDA levels in rat brains. Initial proof of the effectiveness of *C. articulatus* rhizome extract in mice was demonstrated by Rakotonirina *et al.*[14] at 300 mg/kg dosages. Another study by Herrera-Calderon *et al.*[70] found that *C. articulatus* leaf extract, administered orally at a dosage of 150 mg/kg, was effective. Discrepancies in effectiveness may be attributed to reported alkaloids, their absence in rhizome extract, or other factors like solvent, solubility, and species.[70]

Ngo *et al.*[71] proposed that *C. articulatus* leaf extract might directly impact GABA production and protect against brain-generated lipid peroxidation (MDA). The vulnerability of the leaf extract component to lipid peroxidation, disrupting membranes and compromising its efficacy, was noted. Finally, Herrera-Calderon *et al.*[70] observed that leaf extract protected against neuronal injury by inhibiting MDA in mouse brains. Though the exact mechanism of action for the ethanolic extract of *C. articulatus* leaves remains undetermined, the study suggested its potential as a therapeutic option for epileptic seizures.[70, 71]

Anti-onchocercal Properties

The World Health Organization (1991) advocates the use of ivermectin as the primary treatment for onchocerciasis through mass drug administration due to its proven safety and effectiveness against the microfilariae stage of the parasite.[72,73] However, its inefficacy against adult worms and observed encephalopathy and fatalities in certain regions prompt the exploration of alternative medications for onchocerciasis control.[74,75] The emergence of ivermectin-resistant strains further underscores the need for potential replacements.[76]

Natural therapies, particularly plant compounds, present an alternative due to their cost-effectiveness, widespread availability, and minimal side effects.[77] *C. articulatus* rhizomes, known for their antispasmodic, antibacterial, antifungal, and anticonvulsant effects, have shown promise in combating onchocerciasis.[78]

Metuge *et al.*[79] conducted a study in Cameroon, focusing on *C. articulatus* rhizome extracts. *In-vitro* antifilarial activity was assessed against microfilariae and adult worms, with hexane-extracted essential oil proving to be the most effective. The study identified secondary metabolites, including mustakona (AMJ1) and linoleic acid, showing dose-dependent efficacy against *O. ochengi.* The active components of *C. articulatus* could potentially be effective against *O. volvulus,* opening avenues for the development of novel antifilarial medications. Research is ongoing to pinpoint the specific component triggering the highly active state of AMJ1, and these metabolites may serve as blueprints for future antifilarial drug development.[80]

CONCLUSION

Scientific investigations have underscored the potential therapeutic applications of *C. articulatus* rhizome across various human health concerns, encompassing malaria, sedation, hepato protection, contraception, cancer, antioxidant properties, anticonvulsant effects, anti-onchocercal properties, impacts on the central nervous system, and insecticidal and antimicrobial properties. Despite the wealth of promising findings, the transition to conclusive applications in human health necessitates further extensive clinical studies.

While these studies have illuminated the multifaceted benefits of *C. articulatus,* it is crucial to acknowledge that more research, particularly in human subjects, is imperative. Rigorous clinical investigations are essential for validating the purported advantages of plant-based treatments, ensuring their efficacy, and mitigating potential unintended consequences. Additionally, establishing standardized procedures for the plant's utilization, including precise formulations and concentrations, is imperative for its safe and effective integration into medical practices. The comprehensive exploration of *C. articulatus* holds substantial promise, but its full potential awaits the scrutiny of rigorous scientific inquiry and subsequent translation into practical healthcare protocols.

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