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ETHNOBOTANICAL, PHYTOCHEMICAL, AND PHARMACOLOGIES ASPECT OF *Kaempferia rotunda* L. AS A LOCAL HERBAL PLANT WITH GLOBAL POTENTIAL: A REVIEW

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ABSTRACT: *Kaempferia rotunda* L., also known as *kunci pepet*, is a local herbal plant with global potential traditionally used in various medicinal practices across Southeast Asia. This review summarizes the ethnobotanical, phytochemical, and pharmacological aspects of *Kaempferia rotunda* L., to explore its applications in modern medicine. Ethnobotanically, its rhizome has been widely utilized for treating digestive disorders, inflammation, and wound healing. Phytochemical studies reveal that *Kaempferia rotunda* L., contains flavonoids, alkaloids, phenols, and terpenoids, contributing to its biological activities. Several studies have demonstrated significant anti-inflammatory, antibacterial, antioxidant, and anticancer properties. With the increasing demand for natural-based therapies, further exploration of their active compounds and mechanisms of action is highly relevant. This review aims to provide a broader insight into the pharmaceutical potential of *Kaempferia rotunda* L., and encourage further research for the development of evidence-based herbal medicine.

Keywords: Ethnobotany, Herbal Medicine, *Kaempferia rotunda* L., Pharmacology, Phytochemistry.

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INTRODUCTION

Medicinal plants have long been an integral part of traditional medicine in various cultures, especially in Asia, where abundant biological resources support the practice of herbal medicine. One such plant that has a long history of traditional medical use is *Kaempferia rotunda* L., known by various local names such as *kunci pepet* in Indonesia. This perennial herb, belonging to the Zingiberaceae family, has been traditionally used for its medicinal properties in countries like India, Indonesia, and Thailand. Ethnobotanically, *Kaempferia rotunda* has been used in various traditional medicine systems in Southeast Asia, including the Ayurvedic traditional medicine system in India, traditional Chinese medicine, and Jamu in Indonesia. The most used part of the plant is its rhizome, which has been reported to have a wide range of biological activities, including as anti-inflammatory, analgesic, antibacterial, anticancer, and wound-healing

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properties (Diastuti et al., 2020; Krishna et al., 2020; Krishnakumar et al., 2021). In Indonesian traditional medicine, *Kaempferia rotunda* rhizomes are used to treat various health problems such as stomach pain, diarrhea, and inflammation due to bruises or sprains, as well as to eliminate vaginal discharge and tighten female muscles (Aryantini et al., 2023; Raslina et al., 2018). In parts of Southeast Asia, women have traditionally used *Kaempferia rotunda* to alleviate menstrual cramps and regulate menstrual cycles (Pham et al., 2020). This rich ethnobotanical profile highlights the plant's importance in traditional healthcare systems and cultural practices across its native range.

In addition to its use in traditional medicine, scientific research on *Kaempferia rotunda* has been growing in recent decades. Various studies have identified the major phytochemical contents in this plant, including flavonoids, alkaloids, phenols, and terpenoids, which provide the basis for its biological activities (Elshamy et al., 2019; Krishna et al., 2020). Compounds such as quercetin, crotepoxide, and myricetin contained in *Kaempferia rotunda* rhizomes are known to have strong antioxidant effects, which play a role in counteracting free radicals and protecting cells from oxidative stress and have antibacterial activity (Hashiguchi et al., 2022).

Despite the promising ethnobotanical relevance and preliminary pharmacological findings, several critical gaps remain. First, many studies are descriptive or limited to in vitro experiments, lacking translational or clinical evidence. Second, the underlying molecular mechanisms of action, pharmacokinetics, and compound standardization are not yet fully understood. Additionally, most literature focuses on fragmented aspects of the plant’s biology, leading to a lack of an integrated and up-to-date synthesis that bridges traditional knowledge with contemporary biomedical science.

Therefore, this review aims to provide a comprehensive and critical overview of the ethnobotanical uses, phytochemical constituents, and pharmacological activities of *Kaempferia rotunda*. Further exploration of *Kaempferia rotunda* becomes highly relevant, not only to support its traditional utilization but also to open opportunities for the development of herbal-based pharmaceutical products. This review aims to summarize the current information on the ethnobotanical, phytochemical, and pharmacological aspects of *Kaempferia rotunda* and explore its potential applications in modern medicine. This review is expected to provide greater insight into the role of *Kaempferia rotunda* as a medicinal plant with potential health benefits and contribute to further research in pharmaceutical and biotechnology.

METHOD

This study employed a literature review method to synthesize existing knowledge related to the ethnobotanical, phytochemical, and pharmacological aspects of *Kaempferia rotunda* L. The review was conducted by identifying, selecting, and critically analyzing scientific articles published between 2010 and 2024. Data sources included indexed scientific databases such as ScienceDirect, PubMed, Google Scholar, and national journals accredited by the Ministry of Research and Technology of Indonesia (SINTA). The keywords used in the search

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strategy were "*Kaempferia rotunda*", "*kunci pepet*", "ethnobotany", "phytochemical", "pharmacology", "bioactive compound", and "traditional medicine". Inclusion criteria consisted of: 1) original research or review articles focusing on *Kaempferia rotunda*; 2) studies discussing traditional uses, phytochemical constituents, or pharmacological effects; and 3) articles with accessible full text. The initial search yielded 313 articles. After title and abstract screening, full-text assessments, and applying eligibility criteria, a total of 21 articles were included in the final analysis. Exclusion criteria included duplicated studies, articles lacking scientific validity, and those not relevant to the scope of the review. Extracted data were then classified into three main categories: 1) ethnobotanical uses; 2) phytochemical compounds and their solvents; and 3) biological and pharmacological activities.

RESULT AND DISCUSSION

Ethnobotanical and Traditional Uses of *Kaempferia rotunda* L.

Kaempferia rotunda L., known as "*temu pepet*" or "*temu kunci*" is a perennial herbaceous plant belonging to the Zingiberaceae tribe, whose distribution is from India to Indonesia and is commonly found in tropical Asia (Hashiguchi et al., 2022). This rhizomatous plant has been used traditionally in various regions in Indonesia for medicinal purposes, one of which is in East Kalimantan, especially the Dayak tribe who specifically use the rhizomes of this plant for the treatment of indigestion, fever, skin diseases, and accelerate wound healing (Diastuti et al., 2020). In various countries in Southeast Asia, *Kaempferia rotunda* has been widely used as a medicinal plant that has many properties for various diseases (Ragsasilp et al., 2018; Singh et al., 2023). This plant has an interesting morphology, characterized by oval-shaped leaves decorated with brown patterns on the top, and white flowers that produce a fragrant aroma, so it has the potential not only as a medicinal plant but also as an ornamental plant that can be cultivated in pots or in yards (Utami, 2019). *Kaempferia rotunda* plants have an important role in traditional medicine in various countries, with diverse benefits depending on the plant parts and geographical conditions. Ethnobotanical uses in different countries of *Kaempferia rotunda* have been summarized in Table 1.

In India, the leaves of this plant are often used for wound treatment, burns, and reducing swelling, while the rhizome of the plant is often used to treat gastropathy, inflammation, wounds, ulcers, and ulcer prevention (Yadav et al., 2023). The use of the rhizome as a wound and digestive medicine is also found in Indonesia, where this plant is used to treat stomach pain, fever, indigestion, and accelerate wound healing due to bruises or sprains (Diastuti et al., 2020). In Indonesia, in addition to its use in treating stomach pain and indigestion, this plant also has benefits as a slimming ingredient in herbal extracts, treat eliminates vaginal discharge, tightens female muscle. In fact, wider applications include the use of all parts of the plant pounded with salt to relieve fever (Aryantini et al., 2023; Fauziah et al., 2020).

Not only in India and Indonesia, the use of *Kaempferia rotunda* is also found in various other Asian countries. In China, the rhizome is use to treat fever

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and digestive diseases, with the main benefit of accelerating wound healing (Singh et al., 2023). In the Philippines and Malaysia, the rhizome is used to cure stomach pain, heal skin wounds, used in cosmetic formulations and to treat mumps. In Vietnam, this plant has a more specific role in treating menstrual disorders such as dysmenorrhea and menstrual cycle disorders (Pham et al., 2020). Meanwhile, in Thailand, *Kaempferia rotunda* rhizomes are used as a blood booster as well as to treat stomach ulcers, diarrhea, bruises, burns, muscle pain, lumbago, and various skin disorders such as itching (Ragsasilp et al., 2018).

In addition to its long-recognized properties in traditional medicine, recent studies have revealed the broader pharmacological potential of *Kaempferia rotunda*, including as an anti-inflammatory, antioxidant, and anticancer agent. In India, the rhizome of this plant has been shown to have benefits in treating blood clots, tumors, and cancer swelling. This study shows that this plant not only has benefits in traditional medicine but also has potential as a raw material in the development of modern medicines.

Table 1. Ethnobotanical Uses of *Kaempferia rotunda* L.

Plant Parts	Distribution	Ethnobotanical/Traditional Uses	References
Leaf	India	Wound treatments, burns, and reducing swelling.	(Imam et al., 2013).
Rhizome	India	Wound-healing and ulcer prevention.	(Yadav et al., 2023).
Rhizome	Indonesia	Treats stomachache, fever, indigestion, inflammation due to bruises or sprains, pain relief and promote wound healing.	(Diastuti et al., 2020).
Rhizome	Indonesia	Treats diarrhea, abdominal pain, colic, and phlegm, eliminates vaginal discharge, tightens female muscles, wounds inflammation, bruises, and as a slimming ingredient in herbal extracts.	(Aryantini et al., 2023).
Rhizome	China	Treats fever and gastrointestinal diseases, promotes wound healing.	(Singh et al., 2023).
Rhizome	Philippines, Malaysia	Treats abdominal pain, skin wound healing, mumps, and is available in cosmetic formulations.	(Pham et al., 2020).
	Vietnam	Treat stomachaches, menstrual disorders, and dysmenorrhea.	
Whole Plant Part	Indonesia	The whole plant is crushed with salt to relieve fever.	
Rhizome	Indonesia	Treats dysentery and diarrhea used as a slimming agent.	(Fauziah et al., 2020).
Rhizome	India	Treats gastropathy, inflammation, wounds, ulcers, blood clots, tumors, cancerous swelling.	(Mustafaanand, 2014).
Rhizome	Thailand	Blood enhancer, treat stomach ulcers, diarrhea, bruises, wounds, burns, myalgia, lumbago, itching, stomachache/1.	(Ragsasilp et al., 2018).
Rhizome	Indonesia	Treats dysentery, diarrhea and cools the body.	(Utami, 2019).

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From various ethnobotanical studies, it appears that *Kaempferia rotunda* L., is a plant with a wide range of uses, reflecting the wealth of traditional knowledge in various cultures. Further exploration of its active compounds and scientific testing will further strengthen the role of this plant in the medical and pharmaceutical world. As more studies are conducted, it is hoped that this plant can be more widely developed, both in the form of pharmaceutical products, herbal supplements, and as part of alternative therapies based on scientific evidence.

Active Compounds of *Kaempferia rotunda* L.

Kaempferia rotunda L. which has long been used in traditional medicine in various Asian countries, possesses a wealth of bioactive compounds that provide broad pharmacological potential. Based on Table 2, various parts of this plant, especially the rhizomes and leaves, contain a wide array of secondary metabolites that contribute to its biological activities. The rhizome of *Kaempferia rotunda* is the most studied part, as it contains various bioactive compounds, including volatile oils such as bornyl acetate, camphene, pentadecane, and ethyl cinnamate (Saputera et al., 2023). These compounds are known to have anti-inflammatory, analgesic, and antimicrobial properties. In addition, the use of organic solvents such as petroleum ether, cyclohexane, and alcohol in the extraction of rhizomes produces alkaloid, flavonoid, steroid, and phenol compounds (Krishna et al., 2020). A study by Dwira et al. (2020), also showed that *Kaempferia rotunda* rhizomes extracted with ethyl acetate and ethanol contained flavonoids, alkaloids, tannins, and triterpenoids. Furthermore, extraction with n-hexane, methanol, and ethyl acetate yielded a variety of other active compounds, including alkaloids, steroids, terpenoids, flavonoids, and saponins (Kumar et al., 2015). This combination of compounds contributes to the broad pharmacological properties of *Kaempferia rotunda*, including as antimicrobial, antifungal, and immunostimulant agents. Monoterpenes and sesquiterpenes found in the rhizome also have significant therapeutic effects, especially in inhibiting the growth of pathogenic bacteria and fungi (Suphrom et al., 2017). Flavonoids and phenols themselves have been recognized as powerful antioxidants that can help protect cells from oxidative stress.

In addition, more specific studies have shown that *Kaempferia rotunda* rhizomes contain flavanones such as 5-hydroxy-7-methoxyflavanone, 7-hydroxy-5-methoxyflavanone, and 5,7-dihydroxyflavanone, which have antimutagenic activity. These compounds have been shown to protect cells from genetic damage due to exposure to carcinogenic substances. Another study also identified polyphenols such as myricetin, quercetin, and ellagic acid in the rhizome of this plant (Krishnakumar et al., 2021). Polyphenolic compounds are known to have protective effects on cells through antioxidants and anti-inflammatory mechanisms. Apart from rhizomes, the leaves of *Kaempferia rotunda* also contain bioactive compounds that are no less important. Extraction with methanol revealed the presence of flavonoids, crotepoxide, chalcones, quercetin, protocatechuic acid, β-sitosterol, and stigmasterol. These compounds have significant pharmacological effects, including anti-inflammatory agents and antioxidant activity.

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With such diverse phytochemical content, *Kaempferia rotunda* L., has great potential to be developed as a source of active ingredients in modern herbal and pharmaceutical drug formulations. The diversity of secondary metabolites in this plant suggests that in addition to its traditional use, *Kaempferia rotunda* also has strong scientific value for further therapeutic applications. Therefore, more in-depth research into the mechanism of action of each compound as well as clinical testing are needed to support the development of future products based on this plant.

Table 2. Active Compounds of *Kaempferia rotunda* L.

Plant Parts	Solvent	Active Compounds	References
Rhizome	Water	Bornyl acetate, Camphene, Pentadecane, Ethyl cinnamate.	(Saputera et al., 2023).
Tuber	Water	Bornyl acetate, Hexadecane, Ethyl cinnamate.	
Rhizome	Petroleum ether, cyclohexane, acetone, and alcohol.	Alkaloid, flavonoid, steroid, phenol.	(Krishna et al., 2020).
Rhizome	Ethyl Acetate, Ethanol.	Flavonoids, alkaloids, tannins, and triterpenoids.	(Dwira et al., 2020).
Leaf	Methanol	Flavonoids, crotepoxid, chalcones, quercetin, protocatechuic acid, β-sistosterol, stigmosterol, syringic acid.	(Imam et al., 2013).
Rhizome	Methanol	Flavanones (5-hydroxy-7-methoxyflavanone, 7 hydroxy-5-methoxyflavanone, and 5,7-dihydroxyflavanone).	(Atun et al., 2013).
Rhizome	water-ethanol-acetone.	Polyphenol	(Seno et al., 2023).
Rhizome	Ethyl Acetate	Myricetin, Quercetin, Ellagic acid, Cinnamic acid.	(Krishnakumar et al., 2021).
Rhizome	Acetone, *n*-hexane, ethyl acetate.	Benzyl benzoate and crotepoxide	(Diastuti et al., 2020).
Rhizome	*n*-hexane, methanol and ethyl acetate.	Alkaloids, steroids, terpenoids, flavonoids and saponins.	(Kumar et al., 2015).
Rhizome	Hexane, Dichloromethane, Ethanol	Monoterpene (α-pinene, camphene, 1,8-cineole, linalool, camphor, borneol, α-terpineol, 1-bornil asetate), sescuiterpene (ylangene, selinene, gurjunene, curcumene, amorphene, eudesmol), benzil derivative, ethyl ester asam lemak (ethyl palmitate, ethyl linoleate, ethyl stearate).	(Suphrom et al., 2017).

Biological Activities and Pharmacological Potential of *Kaempferia rotunda* L.

Kaempferia rotunda L., which has long been recognized as a medicinal plant in various Asian countries, shows extensive pharmacological potential based on various scientific studies. Various bioactive compounds contained in the rhizomes and other parts of this plant have diverse biological activities, including antimutagenic, antibacterial, anti-inflammatory, antihyperglycemic, anticancer,

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antioxidant, and wound-healing agents (Table 3). Research on the pharmacological activities of *Kaempferia rotunda* is growing and showing promising results in the medical field as well as the pharmaceutical industry.

Table 3. Biological Activity of *Kaempferia rotunda* L.

Plant Parts	Active Compound	Activity	Result	References
Rhizome	Flavanones (5-hydroxy-7-methoxyflavanone, 7 hydroxy-5-methoxyflavanone, and 5,7-dihydroxyflavanone)	Anti-mutagenic	Three flavanone compounds isolated from the rhizomes of *Kaempferia rotunda* (5-hydroxy-7-methoxyflavanone, 7-hydroxy-5-methoxyflavanone, and 5,7-dihydroxyflavanone) demonstrated significant antimutagenic activity, with maximal efficacy observed at a dose of 60 mg/kg body weight, effectively protecting cells against cyclophosphamide-induced chromosomal damage.	(Atun et al., 2013).
Rhizome	Benzyl benzoate and crotepoxide	Anti-bacterial	Benzyl benzoate and crotepoxide from *Kaempferia rotunda* rhizomes exhibited moderate antibacterial activity: benzyl benzoate was most potent against *Bacillus cereus* (MIC 50 µg/mL; inhibition zone 5.9 mm), while crotepoxide was strongest against *Enterococcus aerogenes* (MIC 100 µg/mL; inhibition zone 6.1 mm).	(Diastuti et al., 2020).
Rhizome	(-)-6-acetylzeylenol, four acylated derivatives of 1-benzoyloxymethyl-1,6 epoxycyclohexan-2,3,4,5-tetrol, 3-benzoyl-1-benzoyloxymethylcyclohexa-4,6-dien-2,3-diol, acylated derivatives of salicin, (-)-zeylenol, crotepoxide.	Anti-hyperglycemic Antinociceptive (pain relief)	At a dose of 400 mg/kg, *Kaempferia rotunda* extract reduced glucose levels by 39.6% and reduction in contraction (pain) reached 69.4%.	(Sultana et al., 2012).
Rhizome	Monoterpenes, sesquiterpenes, diterpenes, long-	Anti-androgenic	The hexane extract of *Kaempferia rotunda* showed significant anti-	(Suphrom et al., 2017).

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Plant Parts	Active Compound	Activity	Result	References
	chain hydrocarbons, fatty acid esters, benzyl derivatives, cyclohexane diepoxides, and phytosterols.		androgenic activity, with an IC50 of 0.43 mg/mL, close to the effectiveness of the positive control (ethylnilestradiol, IC50 = 0.26 mg/mL).	
Rhizome	Steroids, Flavonoids, Terpenoids	Wound healing, Anti-inflammation, analgesic	*Kaempferia rotunda* extract enhanced dermal fibroblast viability, proliferation, and migration, and its topical application on excision wounds in male Wistar rats accelerated closure, re-epithelialization, collagen deposition, and reduced inflammation.	(Yadav et al., 2023).
Rhizome	Pinostrobin	Anti-cancer	Improved histopathological changes in breast tissue and suppress the expression of c-Myc oncogene in a mouse xenograft model.	(Atun & Arianingrum, 2017).
Rhizome	Flavonoids, alkaloids, tannins, and triterpenoids	Anti-cancer	The ethanol extract of *Kaempferia rotunda* rhizome showed greater cytotoxicity against HeLa cells (IC_{50} = 16.94 µg/mL) than the ethyl acetate extract, underscoring its anticancer potential.	(Dwira et al., 2020).
Rhizome	Crotepoxide	Antioxidants	Crotepoxide showed strong antioxidant activity as measured by the IC50 of ABTS (38.91 ± 0.59 µg/mL), DPPH (47.45 ± 0.60 µg/mL), and FRAP (26.74 ± 1.23 µg/mL) assays.	(Aryantini et al., 2023).
Rhizome	Alkaloids, tannins, saponins, steroids, terpenes, flavonoids, phenolics.	Antigenotoxic, Antioxidants	*Kaempferia rotunda* methanolic extract reduced cyclophosphamide-induced micronuclei and chromosomal aberrations in mouse bone marrow, increased the mitotic index in *Allium cepa*, and showed antioxidant activity (DPPH IC_{50} = 24.09 µg/mL; hydroxyl radical IC_{50} = 21.74 µg/mL), with maximal antigenotoxicity at 400 mg/kg.	(Chhetri et al., 2024).

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One of the prominent biological activities of *Kaempferia rotunda* is its antimutagenic properties. Flavanone compounds isolated from the rhizome, such as 5-hydroxy-7-methoxyflavanone, 7-hydroxy-5-methoxyflavanone, and 5,7-dihydroxyflavanone, have been shown to have protective effects against chromosomal damage due to cyclophosphamide exposure. One interesting aspect of this plant is its potential as an anticancer agent. The compound pinostrobin found in the rhizome was shown to be able to ameliorate histopathological changes in breast tissue and suppress the expression of the c-Myc oncogene in a xenograft mouse model. In addition Dwira et al. (2020), also reported that ethanol extract of *Kaempferia rotunda* rhizome showed strong cytotoxic activity against HeLa cervical cancer cells, with an IC50 value of 16.939 µg/mL. The anticancer mechanism of action of *Kaempferia rotunda* is thought to be related to its antioxidant and antiproliferative properties that can induce apoptosis in cancer cells. The methanolic extract of *Kaempferia rotunda* also has significant antigenotoxic activity. Studies showed that this extract was able to reduce the frequency of micronuclei and chromosomal aberrations in the bone marrow of mice induced by cyclophosphamide (Chhetri et al., 2024). These effects suggest that this plant may play a role in cellular protection against mutagenic and carcinogenic substances, which could be further utilized in cancer prevention strategies.

In addition to antimutagenic effects, *Kaempferia rotunda* also exhibited significant antibacterial and antiproliferative activities. The compound has agglutination ability against various pathogenic bacteria, including *Bacillus subtilis*, *Shigella sonnei*, and *Klebsiella* sp., and inhibits the growth of Ehrlich ascites carcinoma cancer cells. This discovery opens great opportunities for *Kaempferia rotunda* as a candidate natural chemotherapeutic agent in cancer therapy. Benzyl benzoate and crotepoxide compounds isolated from the rhizome of this plant were also reported by Diastuti et al. (2020), to have the ability to inhibit the growth of various types of pathogenic bacteria. The study showed that benzyl benzoate had the highest effectiveness against *Bacillus cereus* with an MIC value of 50 µg/mL and an inhibition zone of 5.9 mm, while crotepoxide was most effective against *Enterococcus aerogenes* with an MIC of 100 µg/mL and an inhibition zone of 6.1 mm. These antibacterial effects strengthen the potential of *Kaempferia rotunda* as a source of natural compounds for the development of herbal antibiotics.

As well as being an anticancer agent, *Kaempferia rotunda* also exhibits strong antioxidant activity. Crotepoxide, one of the main compounds in the rhizome, has the ability to counteract free radicals with IC50 values of 38,91 µg/mL in the ABTS assay and 47.45 µg/mL in the DPPH assay (Aryantini et al., 2023). This antioxidant ability contributes to protecting cells from oxidative stress damage, which is a major factor in the development of various degenerative diseases.

Antiandrogenic activity is also one of the pharmacological advantages of *Kaempferia rotunda*. Studies by Suphrom et al. (2017), showed that the hexane extract of this plant has an inhibitory effect on androgen activity with an IC50 value of 0.43 mg/mL, close to the effectiveness of the positive control in the form

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of ethinylestradiol. This effect indicates the potential of *Kaempferia rotunda* in the management of androgen-related hormonal disorders. In addition to hormonal effects, *Kaempferia rotunda* has also proven effective in accelerating wound healing, where the anti-inflammatory and analgesic activities of *Kaempferia rotunda* have been widely studied. The rhizome extract of this plant is able to increase the viability, proliferation, and migration of dermal fibroblast cells, which accelerates the wound healing process and reduces inflammation (Yadav et al., 2023). This effect is supported by the presence of steroidal compounds, flavonoids, and terpenoids that are known to have anti-inflammatory properties and accelerate wound epithelialization. Topical application of *Kaempferia rotunda* extract on excision wounds in animal models showed a significant increase in collagen formation and reduction in inflammatory cell infiltration.

In the metabolic sciences, *Kaempferia rotunda* also shows promising antihyperglycemic activity. A methanol extract of the rhizome containing the compound (-)-6-acetylzeylenol and several other acylated derivatives has been tested in animal models, showing a 39.6% reduction in blood glucose levels as well as an analgesic effect with a 69.4% reduction in pain contraction. These results suggest that *Kaempferia rotunda* could potentially be used in the management of diabetes mellitus and the treatment of chronic pain. Further studies are warranted to elucidate the precise mechanisms underlying its antidiabetic and analgesic effects.

Based on various studies, *Kaempferia rotunda* has a broad spectrum of pharmacological activities, making it a plant with great potential in the development of modern herbal medicine. With a variety of scientifically proven biological activities, ranging from antibacterial to anticancer effects, this plant can be a natural source for the development of new therapies that are safer and more effective. However, further research, especially clinical trials, is still needed to ensure the effectiveness and safety of the active compounds contained in these plants before they can be applied in conventional medicine. The integration between ethnobotanical, phytochemical, and pharmacological studies will be an important step in optimizing the therapeutic potential of *Kaempferia rotunda* in the future.

CONCLUSION

Kaempferia rotunda L. demonstrates significant potential as a medicinal plant with supported by its diverse bioactive compounds and broad pharmacological activities. From an ethnobotanical perspective, this plant has been widely used in traditional medicine in various countries, especially in Southeast Asia, to treat digestive disorders, wounds, inflammation, and degenerative diseases. Phytochemically, the presence of flavonoids, alkaloids, terpenoids, and phenolic compounds provides the scientific basis for its biological effects, including anti-inflammatory, antibacterial, antioxidant, and anticancer agents. Further pharmacological research has revealed that *Kaempferia rotunda* extracts exhibit promising therapeutic activity, with potential as a source of active compounds for the development of modern herbal and pharmaceutical drugs.

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SUGGESTION

Future studies should focus on clinically validating the pharmacological effects of *Kaempferia rotunda* L., supported by the isolation and mechanistic analysis of its active compounds. Standardization of extracts and sustainable cultivation are essential to ensure quality and long-term availability. Industrial collaboration is encouraged to develop evidence-based products, with attention to regulatory compliance and intellectual property protection. A multidisciplinary approach is needed to bridge preclinical evidence with modern therapeutic applications.

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