Pharmacogn J. 2022; 14(5): 580-586
A Multifaceted Journal in the field of Natural Products and Pharmacognosy
www.phcogj.com

Research Article

The phytochemical and pharmacological activity of extract Kirinyuh (*Chromolaena odorata* L.) leaves: A Review

Erna Harfiani[1], Yudhi Nugraha[2], Citra Ayu Aprilia[1], Feda Anisah Makkiyah[3], Ratna Puspita[4], Viol Dhea Kharisma[5], Muhammad Hermawan Widyananda[5,6], Ahmad Affan Ali Murtadlo[5], Dora Dayu Rahma Turista[7], Muhammad Badrut Tamam[8], Riso Sari Mandeli[9], Mirella Fonda Maahury[10], Devi Purnamasari[11], Muhammad Arya Ghifari[12], Muhammad Thoriq Albari[12], Muhammad Raffi Ghifari[12], Asmi Citra Malina A. R. Tasakka[13], Alexander Patera Nugraha[14], Rahadian Zainul[15,16,*]

[1]*Department of Pharmacology and Pharmacy, Medical Faculty, UPN Veteran Jakarta, Jakarta, INDONESIA.*
[2]*Badan Riset dan Inovasi Nasional, Jakarta, INDONESIA.*
[3]*Department of Surgery, Medical Faculty, UPN Veteran Jakarta, Jakarta, INDONESIA.*
[4]*Department of Biochemistry, Medical Faculty, UPN Veteran Jakarta, Jakarta, INDONESIA.*
[5]*Division of Molecular Biology and Genetics, Generasi Biologi Indonesia Foundation, Gresik, INDONESIA.*
[6]*Department of Biology, Faculty of Mathematics and Natural Sciences, Brawijaya University, Malang, INDONESIA.*
[7]*Biology Education Department, Faculty of Teacher Training and Education, Mulawarman University, Samarinda, INDONESIA.*
[8]*Department of Biology, Faculty of Sciences and Technology, Universitas Muhammadiyah Lamongan, Lamongan, INDONESIA.*
[9]*Environmental Science, Postgraduate Programme, Universitas Negeri Padang, Padang, INDONESIA.*
[10]*Department of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Pattimura, Ambon, INDONESIA.*
[11]*Department of Radiology Engineering, Universitas Awal Bros, Pekanbaru, INDONESIA.*
[12]*Department of Informatics Engineering, Faculty of Computer Sciences, Universitas Brawijaya, Malang, INDONESIA.*
[13]*Faculty of Marine Science and Fisheries, Universitas Hasanuddin, Makassar, INDONESIA.*
[14]*Department of Orthodontics, Faculty of Dental Medicine, Universitas Airlangga, Surabaya, INDONESIA.*
[15]*Center for Advanced Material Processing, Artificial Intelligence, and Biophysic Informatics (CAMP-BIOTICS), Universitas Negeri Padang, Padang, INDONESIA.*
[16]*Department of Biology, Faculty of Mathematics and Natural Sciences Universitas Negeri Padang, Padang, INDONESIA.*

Correspondence

Rahadian Zainul

Center for Advanced Material Processing, Artificial Intelligence, and Biophysic Informatics (CAMP-BIOTICS), Department of Biology, Faculty of Mathematics and Natural Sciences Universitas Negeri Padang, Padang, INDONESIA.

E-mail: rahadianzmsiphd@fmipa.unp.ac.id

History

- Submission Date: 28-07-2022;
- Review completed: 25-08-2022;
- Accepted Date: 16-09-2022.

DOI : 10.5530/pj.2022.14.139

Article Available online

http://www.phcogj.com/v14/i5

ABSTRACT

C. odorata L. is considered to be a plant weed that is scattered in various climates. As a weed, this plant contains a variety of beneficial secondary metabolites. Several studies have shown the benefits of *C. odorata* L. leaf extract. This study reviews the metabolite content and the pharmacological activities of *C. odorata* L. leaf extract. A literature search was carried out to obtain various studies related to the use of this plant extract. Secondary metabolites identified in *C. odorata* L. are alkaloids, flavonoids, tannins, saponins, and steroids. Several reports have also shown that even though it is considered a weed, *C. odorata* L. leaf extract also provides many benefits due to its pharmacological activities. Various pharmacological activities include anti-inflammatory, anti-microbial, antioxidant, antidyslipidemia, hematologic agent, anti-diabetic and anti-cataract, analgesic and antipyretic, wound healing, anti-malaria, mosquito larvicidal, anti-hypercholesterolemia, and antifungal.

Key words: Characterization, *Chromolaena odorata*, kirinyuh, Pharmacological activity, Phytochemical.

INTRODUCTION

The Asteraceae plant family includes the perennial shrub *Chromolaena odorata* (L.) R.M. King & H. Rob., also known as Kirinyuh in the local Indonesian language. The invasive shrub *C. odorata L.* is native to America. In a short period, the plant spread fast to other countries in southern and western Africa, eastern and southern Asia, and Australia, where it became one of the most prevalent shrub species in agriculture.[1] For instance, the second-most common invasive plant species in South Africa was *C. odorata L. C. odorata L.* thrives in a range of ecological conditions, including dissimilar to the plant's original habitat. The ability of *C. odorata L.* is thought to be due to some characteristics, including the plant's rapid reproduction rate, high nutrient assimilation rate, suppressive effect on other plant species, and growth adaptability under diverse soil and climatic circumstances.[2]

Although it can grow invasively, *C. odorata* L. has historically been valued for various medical qualities. Local medical professionals use the plant to treat wounds, fungal infections, coughs, headaches, toothaches, diarrhea, stomach disorders, and dysentery. The plant is said to have antibacterial, anti-inflammatory, anti-diarrhea, anti-analgesic, anti-cancer, anti-diabetic, antioxidant, wound healing, and hemostatic properties. However, some of these uses have not been scientifically proven.[3,4] As a result, many chemical components that could cause the observed biological characteristics have been discovered by analyzing plant materials extracted from *C. odorata* L. There are phenolics, flavonoids, saponins, terpenoids, tannins, and steroids in the leaves of *C. odorata* L.[5] Researchers also discovered phenolic acids, such as protocatechuic acid, ferulic acid, vanillic acid, and combinations of flavonoid aglycones like sinensetin, rhamnetin, tamarixetin, and kaempferide, in column fractions of an ethanol extract of *C. odorata* L. leaves.[6] The hydro-distilled essential oil from the root of *C. odorata* L. contains the sesquiterpenes himachalol, 7-isopropyl-1,4-dimethyl-2-azulenol, androencecalinol, and 2-methoxy-6-(1-methoxy-2-propenyl) naphthalene as its main bioactive components. Many chalcones, such as acacetin, luteolin, isosakuranetin, persicogenin, 5,6,7,4′-Tetramethoxyflavanone, 4′-hydroxy-5,6,7-trimethoxyflavanone, and others, were also extracted from the flower's dichloromethane extract.[7]

C. odorata L. may contain lead substances with noteworthy *in vitro* and *in vivo* therapeutic effects. Studies on the plant's therapeutic efficacy have been conducted in Asia and sub-Saharan Africa. The process by which the plant exerts its pharmacological properties is still unknown.[8] As a result, the purpose of this review was to provide insights into the *C. odorata* L. phytochemical and pharmacological.

PHARMACOGNOSY *C. ODORATA* L.

Description

C. odorata L. or Kirinyuh is a wild plant native to Central and South America that spreads throughout the world, especially in tropical and subtropical areas, as shown in Figure 1.[9] Economically and ecologically, *C. odorata* L. is considered detrimental due to negative impact on agriculture, biodiversity, and livelihoods in the area.[10] *C. odorata* L. quickly grows easily and is widespread in tropical regions, even in grasslands where grass cannot be

Cite this article: Harfiani E, Nugraha Y, Aprilia CA, Makkiyah FA, Puspita R, Kharisma VD, et al. The phytochemical and pharmacological activity of extract Kirinyuh (*Chromolaena odorata* L.) leaves: A Review. Pharmacogn J. 2022;12(5): 580-586.

Figure 1: Kirinyuh *(C. odorata. L).*

raised.[11] *Different names in each area know C. Odorata* L., for example, Acheampong, Jabinde, Matapa, Mighbe, Sekou Toure (Africa); Herbe du Laos (France); Siam kraut (German); Kesengesil (Guam); Bagh Dhoka, Tivra Gandha (India); Grasshopper Grass, Golkar Grass, Kirinyuh, Pakoasi, White Grass (Indonesia); Japanese Grass, Main Aircraft, Siamese Grass (Malaya); Ropani, Seekhrasarpi (Sanskrit); Cariaquillo Santa Maria (Spain); Agonoi, Hagonoy, Huluhagonoi (Tagalog); Sab Suea (Thailand); Choi (Vietnam) and Christmas bush, Communist weed, Devil weed, Jack in The Bush, Siam weed, Sunflower family (UK);[12] *C. odorata* L. has about 900 genera and 13,000 species and is a shrubby plant that can grow as high as 3-7 m in the open area.[13]

Taxonomy of *C. odorata* L.

C. odorata L. taxonomy can be seen below:[14]

Kingdom	:	*Plantae*
Subkingdom	:	*Viridiplantae*
Infrakingdom	:	*Streptophyta*
Superdivision	:	*Embryophyta*
Divisi	:	*Tracheophyta*
Subdivision	:	*Spermatophyta*
Class	:	*Magnoliopsida*
Superorder	:	*Asteraceae*
Ordo	:	*Asterales*
Family	:	*Asteraceae*
Genus	:	*Chromolaena*
Species	:	*Chromolaena odorata* (L.) *R.M. King & H. Rob.*

Morphology

Macroscopic

Leaf: In the observation of fresh Kirinyuh leaves, it has a *jorong* leaf shape, the top and bottom edges are pointed, with jagged leaf edges, and the upper and lower surfaces of the leaves are green. Leaf length ranges from 6.4 to 11.8 cm, width from 3.3 to 5.9 cm. The leaf bones are pinnate, the leaf's texture has fine hair, and the position of the single leaf is opposite (Figure 2).[15] The leaves grow in pairs along the trunk and branches.[12]

Trunk: Kirinyuh can grow to about 2-3 m with straight and brittle stems

Flower: Kirinyuh has 15-25 tubular blossoms per head. Each is 10 mm long and white, purple, pink, or blue, as shown in Figure 3.[16]

Seeds and Roots: The seeds are brown-gray to black, 4-5 mm long, and have pale brown pappuses 5-6 mm long. The roots are narrow and fibrous, reaching an average depth of 0.3 km.[12]

Microscopic

Microscopically, Kirinyuh leaves are composed of epidermal tissue, collenchyma, sponge and trichomes, collateral vessel bundle type, and a normocytic stomata type. A palisade is located just below the epidermis, and the cuticle protects the epidermis. This plant has various collateral vascular bundles (Figure 4).[15]

Chemical Content of Daun Kirinyuh (*C. odorata L.)*

The composition of the compounds contained in Kirinyuh leaves can be seen in Table 1 below.[6,17,18]

Kirinyuh leaves contain a variety of potent phytochemicals that includes (a) flavonoid aglycones (flavanones, flavonols, flavones), including acacetin, chalcones, paxillin, luteolin, naringenin, kaempferol, quercetin, quercetagetin, and sinensetin, (b) terpenes and terpenoids, (c) essential oils, (d) alkaloids, namely pyrrolizidine, (e) saponins and tannins, (f) phenolic acids, namely ferulic acid and protocatechuic acid, and (g) phytoprostane components, namely chromomeric acid, as shown in Figure 5.[12] Triterpenes/steroids, monoterpenes, sesquiterpene hydrocarbons, and essential oils (geyren, bornyl acetate, and β-eubeden) are also present in Kirinyuh.[13]

The fresh Kirinyuh leaves contain carbohydrates (20.58%), crude protein (6.56%), fiber (10.76%), moisture (59.50%), natural fat (0.10%), total powder (2.50%), and total metabolic energy of 109.46 kcal / 100g. In comparison, the dry preparation contains various components, namely: carbohydrates (31%), crude protein (18%), fiber (15%), moisture (15%), natural fat (11%), and powder (11%).[17]

Based on *C. odorata L.* research, there are 17 compounds were isolated, namely: 1,2-methylenedioxy-6-methylanthraquinone, 3-hydroxy-1,2,4-trimethoxy-6-methylanthraquinone, 3-hydroxy-1,2dimethoxy-6-methylanthra-quinone, 5aα, 6,9,9aβ, 7-methoxy-7-epi-medioresinol, 10-pentahydro-10β-hydroxy-7-methylanthra, and dioxol-5-one. Known compounds in *C. odorata L.* include 3-acetyloleanolic acid,

Table 1: The composition of compounds in Kirinyuh (*C. odorata L.*) leaves.

Component	Status
Alkaloids	+
Cyanogenic glycosides	+
Flavonoids	
Z Aurone	+
Z ChalcDaunone	+
Z Flavone	+
Z Flavonol	+
Phytates	++
Saponins	+++
Tannins	++
Steroid	+
Terpenoid	+

(+) = low levels; (++) = sufficient levels; (+++) = high levels

Table 2: Phytochemical examination of methanol extract and distilled water *C. odorata*.

Phytochemicals	Methanolic extracts	Aqueous extracts
Alkaloids	+	-
Saponins	-	+
Tannins	+	+
Anthraquinones	-	+
Steroids	+	+
Terpenoids	+	+
Flavonoids	+	+

(+) = Contains; (-) = Does not contain

Figure 2: Macroscopic Observation Results of Kirinyuh (*C.odorata L.)* Leaves
a) front view; b) rearview; and c) whole plants.

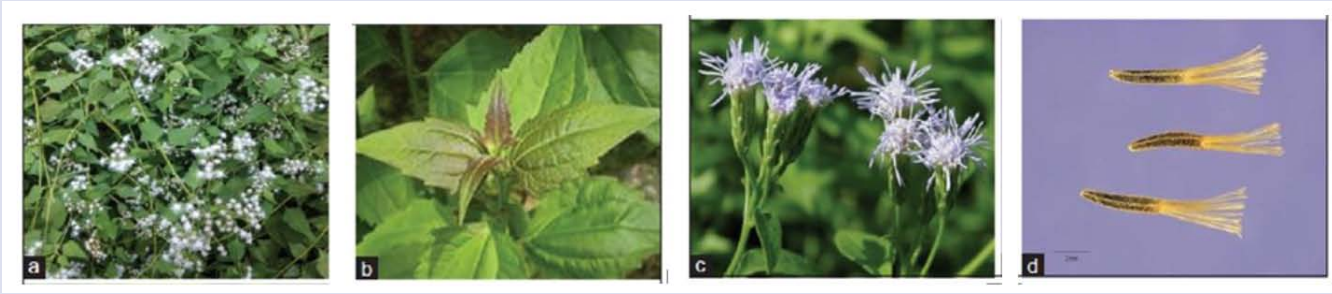


Figure 3: Plant parts of *C. odorata* L. (a) stems, (b) leaves, (c) flowers, (d) seeds

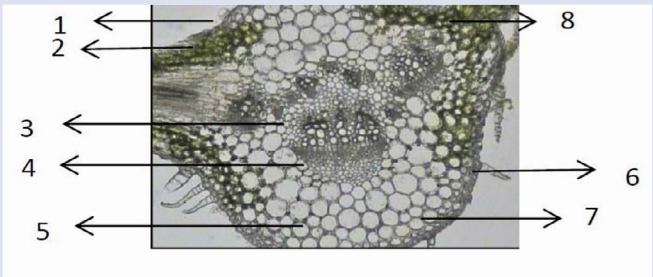


Figure 4: Cross-section of fresh Kirinyuh (*C. odorata* L.*)* leaves (Floroglusin HCl media, magnification 10 × 42.3).

1. upper epidermis; 2. palisade; 3. xylem; 4. phloem; 5. parenchyma tissue; 6. trichomes; 7. lower epidermis; 8. Sponge.

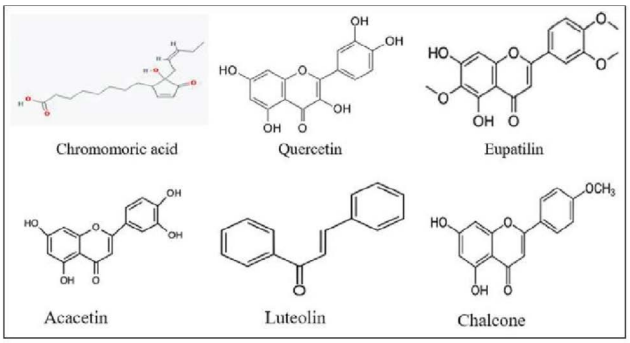


Figure 5: A phytochemical compound in *C. odorata* L.

5', 6'-trime-thoxychalcone, (-) pinoresinol austrocortinin, (-)-medioresinol, (-)- syringaresinol, cleomiscosin A, cleomiscosin D, odoratin, ombuin, 4,2'-dihydroxy-4 ', ursolic acid, and tianshic acid.[9]

Phytochemical content contained in methanol extract and distilled water extract

A qualitative phytochemical examination of methanol extract and distilled water was carried out on *C. odorata L.*, and the results obtained in Table 2 are as follows:[19]

Pharmacological activities of Kirinyuh (*C. odorata L.*) leaves

Some of the pharmacological activities shown by Kirinyuh leaves include and as shown in Table 3:

Anti-inflammatory: The flavonoid content in *C. odorata* L. leaf extract shows anti-inflammatory activity *in vitro* and *in vivo*.[16] The aqueous extracts of *C. odorata* L. were administered to the rats implanted with a cotton pellet and showed to reduce granuloma formation. The doses of 100 and 200 mg/kg significantly decreased the formation of granulomas ($P < 0.05$). *C. odorata* L. leaf extract reduced chronic inflammation (expressed by the cotton pellet method) in this test with higher doses of the extract. Granulation is caused by leukocyte buildup, which is probably less effective when administered in smaller amounts. Tamarixetin and kaempferide, 4-methyl ethers of quercetin and kaempferol flavonols, may work together to reduce inflammation. Kaempferol and quercetin both showed high potency of antioxidant and anti-inflammatory effects.[20]

Anti-microbial: In the research that has been done, the pharmacological effects found in *C. odorata L.* can be helpful as an anti-microbial.

Table 3: Some pharmacological activities of Kirinyuh leaf extract (*C. odorata L.*).

No	Pharmacological Activities	Results	Research
1.	Anti-inflammatory	The flavonoid content in Kirinyuh leaf extract shows anti-inflammatory activity.	(16)
2.	Anti-microbial	*C.odorata L.* leaf extract showed resistance activity against *Mycobacterium tuberculosis*. Flavonoids in *C.odorata L.* extract can reduce the growth of *S. aureus,* with RF 0.9 in TLC.	(16) (19)
3.	Antioxidants	The methanol extract of *C. odorata* L. leaves showed strong inhibitory activity using the DPPH method.	(22)
4.	Antidyslipidemia	Kirinyuh leaf extract contains flavonoids (79.63 ± 4.55 mg/100 g). The *C. odorata* L. extract significantly reduced LDL and TG levels and increased HDL concentrations in mice.	(29)
5.	Hematologic agent	As a hematologic agent, the ethanol extract of *C. odorata* L. leaves can be useful since it shortens the bleeding period in mice (2.5 min) without producing platelet aggregation or blood clotting in vitro.	(24)
6.	Anti-diabetic and anti-cataract	Therapy for ACO reversed STZ-induced diabetes and cataract in rats and positively affected diabetes mellitus and associated complications. This study provided evidence that taken as a whole, supports the use of *C. odorata* L. in traditional medicine. A root extract from *C. odorata* L. showed anti-diabetic and hepatic impairment-preventive properties.	(25) (26)
7	Analgesic and anti-pyretic	Several fractions of *C.odorata L.* (CDF, nBF, and EAF) showed analgesic, anti-inflammatory, and antipyretic activity. Furthermore, the nBF fraction, where this biological activity is related to flavonoids in it.	(27)
8.	Wound healing	The use of *C. odorata* L. in wound healing has been established. The plant extract promotes neovascularization and cell migration, increases hemostatic activity, reduces inflammation, and stimulates cell proliferation.	(13)
9	Anti-malaria	Ethanol leaf extracts of *C.odorata* L. and *Cymbopogon citratus* showed blood schizontocidal activity with significant results ($p < 0.05$) within four days compared with the standard drug chloroquine.	(20)
10	Mosquito larvicidal	The methanolic leaf extract of *C. odorata* L. has anti-larval activity against the vector, *An. stephensi. Cx quinquefasciatus* and *Ae. Aegypti.*	(30)
11.	Antihypercholesterolemia	Ethanol extract of Kirinyuh leaves (*C. odorata* L.) can lower total cholesterol levels on Wistar strain male white rats given a high-fat diet, with the best concentration being 60 mg/kg BW in mice.	(6)
12	Antifungal	*Microsporum gypseum*, *Cryptococcus neoformans*, *Trichophyton rubrum,* and *Trichophyton mentagrophytes* are all inhibited in vitro by extract and fractions of *C. odorata* L., having an inhibitory concentration range for the extract of 62.5 to 500 g/ml and the fractions of 25 to 100 g/ml. The most susceptible organisms to the aqueous and ethanol extracts of *C. odorata* L. were Aspergillus niger, Candida albicans, and Aspergillus oryzae. At the same time, *Geotrichum sp.* and *Penicillium notatum* displayed considerable resistance to bioactivity. Nevertheless, all of them were sensitive to Nystatin (10 mg/dl).	(28) (28)

Kirinyuh leaf extract contains dichloromethanolic and ethanolic, which can fight 22 bacterial strains of various Gram (+) and Gram (-) bacteria. This leaf extract also shows resistance activity against *Mycobacterium tuberculosis*. Several studies have shown that *C. odorata L.* has good antifungal activity and found nematicidal activity.[16]

One research stated that *C. odorata L.* extract with the active constituent of flavonoids could reduce the growth of *S. aureus,* which proved that the RF result in TLC was 0.9.[19]

Antioxidants: *C. odorata L.* shows high antioxidant activity. Research shows that phenolic acids are present in *C. odorata* L. extracts, such as p-coumaric, ferulic, protocatechuic, p-hydroxybenzoic, and vanilla acid. Various hydrolobic complexes of aglycone flavonoids such as flavones, flavanones, chalcones, and flavonols are present in *C. odorata* L. as the primary and potent antioxidants.[21] Nitric oxide (NO) is also found in Kirinyuh extract, the most abundant phenolic compound. NO in *C. odorata L.* is responsible for its antioxidant potential.[16]

The researcher stated that the methanol extract of *C. odorata* L. leaves showed inhibitory activity using the DPPH (2,2-diphenyl-1-pikrilhidrazil) radical inhibition method with IC_{50} values of 63.95, 64.38, and 202.15 ug/ml, with gallic acid as control positive (5.29 ug/ml).[22]

Antidyslipidemia: The researcher stated that Kirinyuh (*C. odorata L.*) leaf extract could reduce blood glucose levels and lipid profile concentrations, namely VLDL, LDL, Triacylglycerol, and total cholesterol in white mice. This study also found an increase in HDL levels in the blood. This study's dose of Kirinyuh leaf extract was 20 mg/kg BW.[23]

Hematologic agent: Ethanol extract of *C. odorata L.* shows an effect as a hematologic agent, namely an anticoagulant. The mechanism of this plant works on stimulation of coagulation on factor 12. However, using extracts and isolation in large doses will cause hepatoxicity to the liver and kidneys.[24]

Antidiabetes and anti-cataract: When diabetic rats (administrated with STZ streptozotocin; 45 mg/kg, iv) were given an ethanol extract of *C. odorata* L. leaves (ACO), blood sugar levels, lipid profiles, glycogen content, glucose absorption by skeletal muscle, serum insulin levels, and HDL-c levels all considerably decreased. By enhancing endogenous antioxidants, ACO also reduced oxidative stress. The ACO administration also provides important outcomes from the initiation and progression of cataracts.[25]

The metabolic parameters of rats with alloxan-induced diabetes were examined to determine how the methanol root extract of *C. odorata* L. affected those parameters. *C. odorata* L. had IC_{50} values of 533.05 g/ml and 679.12 g/ml for its effects on amylase activity and glycosylated hemoglobin, respectively. The *in vivo* hypoglycemic effects of extracting doses of 300 and 600 mg/kg body weight were 49.86% and 68.30%, respectively. The increase in animal weight reached 13.23 and 13.87 g, respectively. Alkaline phosphatase (ALP), aspartate transaminase (AST), bicarbonates, chloride, salt, and total protein concentrations were increased significantly ($P < 0.05$). The albumin, total bilirubin, and direct bilirubin levels were lower in untreated diabetic rats than in the control group. Untreated diabetic rats had lower albumin and total and direct bilirubin levels than the control group. Treatment with extract at 300 and 600 mg/kg body weight considerably returned the AST, ALP, albumin, direct and total bilirubin, and total proteins to normal levels compared to the untreated control ($P < 0.05$). The increased bicarbonates, chloride, creatinine, sodium, and urea levels could not be attenuated significantly ($P > 0.05$).[26]

Analgesic and Anti-pyrexia: Phytochemical examinations were carried out on several leaf fractions of *C. odorata L.,* namely dichloromethane (DCF), ethyl acetate (EAF), and n-butanol (nBF) fractions. The results showed that the DCF fraction showed analgesic, anti-inflammatory, and antipyretic activity. Next is the nBF fraction, and finally, the EAF. This biological activity is related to the presence of flavonoids in each fraction.[27]

Wound healing Source: It has been established that *C. odorata* L. is generally safe for wound healing and can treat exterior and internal wounds with its wound-healing agent. By promoting TXS and inhibiting MMP-9 production, *C. odorata* L. extract stimulates hemostatic action. It also initiates the expression of HO-1 (Heme oxygenase-1) by activating the MEK, p38 MAPK, Akt, and JNK kinase pathways. Inhibiting inflammation, promoting cell growth, increasing neovascularization, and encouraging cell migration are all effects of HO-1 induction that will aid in wound healing.[13]

Anti-malaria: Ethanol leaf extracts of *C. odorata* L. and *Cymbopogon citratus* showed anti-plasmodial activity (*P. berghei*). Blood schizontocidal activity gave significant results ($P < 0.05$) within four days compared with the standard drug chloroquine (5 mg/kg/day).[20]

Antifungal: The researcher stated yeasts and filamentous fungi were used to test an aqueous ethanol extract of C. odorata L. leaves and some of its fractions for their antifungal capabilities. *Microsporum gypseum, Cryptococcus neoformans, Trichophyton rubrum*, and *Trichophyton mentagrophytes* are all inhibited *in vitro* by extract and fractions. The inhibitory concentrations ranged from 62.5 to 500 g/ml for the extract and from 25 to 100 g/ml for fractions.[28]

C. odorata L. showed that all the test fungi were vulnerable to the hot water and ethanolic extracts, which inhibited growth at 100 mg/ml and 50 mg/ml concentration. The three molds with the highest susceptibility to the aqueous and ethanol extracts were *Aspergillus niger, Candida albicans*, and *Aspergillus oryzae. Geotrichum* sp. and *Penicillium notatum* showed some resistance to the bioactivity of the aqueous and ethanol extracts. Nevertheless, all of them were sensitive to Nystatin (10 mg/dl).[28]

Toxicity of *C. odorata* L.

Administration of *C. odorata L.* leaf water extract can reduce levels of amylase, albumin and total serum protein, and Na + at doses of 538.5 mg/kg and 1077 mg/kg and can cause an increase in serum creatine kinase, AST, K +, glucose, uric acid levels, urea and creatinine.[27]

Long-term use and large doses of *C. odorata L.* extract (> 250 mg/kg body weight) can cause side effects on kidney function and histological changes in rat intestines.[21]

Pyrrolizidine alkaloids (PAs) in *C. odorata* L. may be toxic to grazing animals like cattle and goats. It has been demonstrated that pyrrolizidine alkaloids exhibit a wide range of genotoxic effects. Clinical research must be done to determine the safe dosage range for treating different diseases because PAs can be dangerous to humans and animals.[31,32,33]

CONCLUSION

In summary, Indonesia is known as megabiodivesity country with numerous medicinal plants.[34,35,36,37,38,39,40] However, the leaves of kirinyuh (*Chromolaena odorata L.*) are shrubs that originated from America and spread across Indonesia, Africa, and the Pacific. Kirinyuh leaves are a medicinal plant that contains alkaloids, flavonoids, tannins, saponins, and steroids. Various pharmacological benefits include anti-inflammatory, anti-microbial, antioxidant, antidyslipidemia, hematologic agent, anti-diabetic and anti-cataract, analgesic and antipyretic, wound healing, anti-malaria, mosquito larvicidal, anti-hypercholesterolemia and antifungal. From the results of this study, it can be estimated that Kirinyuh *(C. odorata* L.) has sufficient potential as a medicinal raw material. More in-depth research is needed for future development.

CONFLICTS OF INTEREST

There are no conflicts of interest in the preparation of this article.

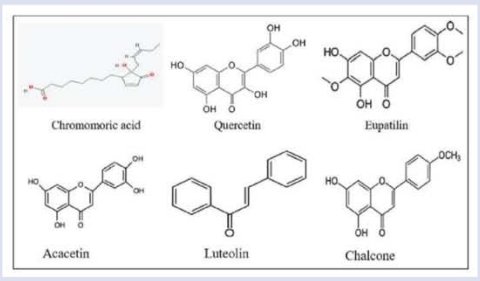
REFERENCES

1. Ajay A, Rupesh MK, Shamal PAB, Abhishek K, Gowda SK, Ramesh B. Pharmacological Importance of *Chromolaena odorata*: a review. Int J Pharm Drug Anal. 2021;9(1):8-11.
2. Olawale F, Olofinsan K, Iwaloye O. Biological activities of *Chromolaena odorata*: A mechanistic review. S Afr J Bot. 2022;144(144):44-57.
3. Huynh BV. Optimization of total phenolic extraction of *Chromolaena odorata* leaf for antifungal activity against plant pathogens. J Agric Dev. 2020;18(6).
4. Ramdani F, Sriasih M, Drajat AS. The Effect of Pakoasi (*Chromolaena odorata* L.) Leaf Extract in Curing Open Wound of Rabbit Skin (*Oryctolagus cuniculus*). In Proceedings of the 2nd International Conference Postgraduate School - Volume 1: ICPS. 2019;1:457-61.
5. Yenti R, Afrianti R, Endang PA. Formulasi Krim Ekstrak Etanol Daun Kirinyuh (*Eupatorium odoratum* L.) sebagai Antiinflamasi. Scientia: J Farmasi dan Kesehatan. 2016;4(1).
6. Yohanes I, Koban R, Klau ME, Rame MM. Uji Aktivitas Antihiperkolesterolemia Ekstrak Etanol Daun Kirinyuh (*Chromolaena odorata* L.) Terhadap Tikus Putihi (*Rattus norvegicus* L.) Jantan yang Diinduksi Diet Lemak Tinggi. CHMK Pharm Sci J. 2019;2(2):73-82.
7. Joshi RK. Chemical composition of the essential oil of *Chromolaena odorata* (L.) R. M. King & H. Rob. Roots from India. J Chem. 2013;2013:1-4.
8. Ekananda N. Bay Leaf in Dyslipidemia Therapy. J Majority. 2015;4(4).
9. Bhuyan M, Deb P, Dasgupta D. *Chromolaena odorata*: As Nature's Wound Healer. Int J Curr Pharm Res. 2019;11(4):63-5.
10. Omokhua AG, McGaw LJ, Finnie JF, van Staden J. *Chromolaena odorata* (L.) R.M. King & H. Rob. (Asteraceae) in sub-Saharan Africa: A synthesis and review of its medicinal potential. J Ethnopharmacol. 2016;183.
11. Madhavan M. Quantitative Estimation of Total Phenols and Antibacterial Studies of Leaves Extracts of *Chromolaena odorata* (L.) King & H.E. Robins. Int J Herb Med. 2015;3(2):20-3.
12. Sirinthipaporn A, Jiraungkoorskul W. Wound Healing Property Review of Siam Weed, *Chromolaena odorata*. Pharmacogn Rev. 2017;11(21):35-8.
13. Vijayaraghavan K, Rajkumar J, Bukhari SNA, Al-Sayed B, Seyed MA. *Chromolaena odorata*: A Neglected Weed with a Wide Spectrum of Pharmacological Activities (Review). Mol Med Rep. 2017;15(3):1007-16.
14. ITIS. Integrated Taxonomic Information System (ITIS). Enciclopedia de la Vida (EOL). 2022.
15. Ance PE, Wijaya S, Setiawan HK. Standarisasi dari Daun Kirinyuh (*Chromolaena odorata*) dan Simplisia Kering dari Tiga Daerah yang Berbeda. J Farmasi Sains dan Terapan. 2019;5(2).
16. Kanase V, Shaikh S. A Pharmacognostic and Pharmacological Review on *Chromolaena odorata* (Siam weed). Asian J Pharm Clin Res. 2018;11(10):34-8.
17. Zahara M. Description of *Chromolaena odorata* L. R.M King and H. Robinson as Medicinal Plant: A Review. IOP Conf Ser Mater Sci Eng. 2019;506.
18. Aziz NA, Mohamad M, Mohsin HF, Mohamad NA, Hamid KA. The Pharmacological Properties and Medicinal Potential of *Chromolaena odorata*: A Review. Int J Pharm Nutr Cosmet Sci. 2020;2:30-41.

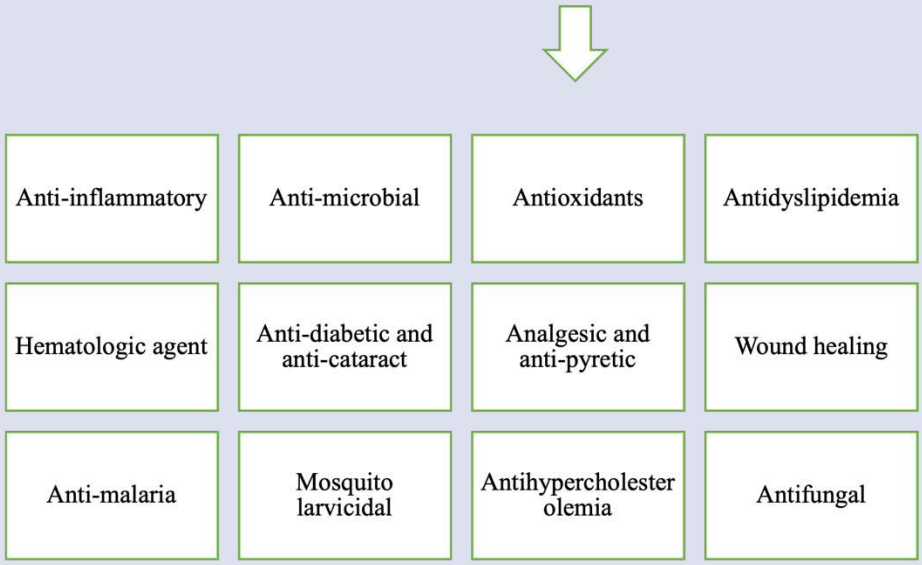
19. Rofida S, Nurwahdaniati. Antibacterial Activity of *Chromolaena odorata* (L) King Leaves with Bioautography. Pharm. 2015;12(1).
20. Ukpai OM, Amaechi EC. Evaluation of in Vivo Antimalarial Activity of the Ethanolic Leaf Extracts of
21. *Chromolaena Odorata* and *Cymbopogon Citratus* in Mice. Niger J Biotechnol. 2012;24.
22. Anyanwu S, Inyang IJ, Asemota EA, Obioma OO, Okpokam DC, Agu VO. Effect of Ethanolic Extract of *Chromolaena odorata* on the Kidneys and Intestines of Healthy Albino Rats. Integr Med Res. 2017;6(3):292-99.
23. Maulida PA, Putri DA, Fatmawati S. Free Radical Scavenging Activity of *Chromolaena odorata* L. Leaves. IPTEK J Technol Sci. 2019;30(3).
24. Uhegbu FO, Imo C, Onwuegbuchulam CH, Friday C, Uhegbu O. Lipid Lowering, Hypoglycemic and Antioxidant Activities of *Chromolaena odorata* (L) and *Ageratum conyzoides* (L) Ethanolic Leaf Extracts in Albino Rats. J Med Plants Studies. 2016;4(2).
25. Pandith H, Thongpraditchote S, Wongkrajang Y, Gritsanapan W. In vivo and in vitro hemostatic activity of
26. *Chromolaena odorata* leaf extract. Pharm Biol. 2012;50(9):1073-77.
27. Onkaramurthy M, Veerapur VP, Thippeswamy BS, Reddy TNM, Rayappa H, Badami S. Anti-Diabetic and Anti-Cataract Effects of *Chromolaena odorata* Linn.; In Streptozotocin-induced Diabetic Rats. J Ethnopharmacol. 2013;145(1):363-72.
28. Omonije OO, Saidu AN, Muhammad HL. Anti-Diabetic Activities of *Chromolaena odorata* Methanol Root Extract and its Attenuation Effect on Diabetic Induced Hepatorenal Impairments in Rats. Clinical Phytoscience. 2019;5(1).
29. Asomugha RN, Okafor PN, Ijeh II, Orisakwe OE, Asomugha AL, Ndefo JC. Toxicological Evaluation of Aqueous Leaf Extract of *Chromolaena odorata* in Male Wistar Albino Rats. J Appl Pharm Sci. 2013;3(12):89-92.
30. Ahumibe, Donatus JM, Elochukwu IC. Phytochemical and Antifungal Properties of *Chromolaena odorata* (Siam Weed) Leaves. Eur J Biomed Pharm Sci. 2019;6(10):18-23.
31. Omonije OO, Saidu AN, Muhammad HL. Antioxidant and Hypolipidemic Effects of Methanolic Root Extract of *Chromolaena odorata* in Alloxan-induced Diabetic Rats. Iranian J Toxicol. 2020;14(2).
32. Sukhthankar JH, Kumar H, Godinho MHS, Kumar A. Larvicidal Activity of Methanolic Leaf Extracts of Plant, *Chromolaena odorata* L. (Asteraceae) Against Vector Mosquitoes. Int J Mosq Res. 2014;1(3):33-8.
33. Fabian CO, Nwokwu PC, Ukazu ER. Toxicological Assessment of *Chromoleana odorata* on *Clarias gariepinus* Juveniles. J Appl Sci. 2018;8(6):271-83.
34. Kharisma VD, Probojati RT, Murtadlo AAA, Ansori ANM, Antonius Y, Tamam MB. Revealing Potency of Bioactive Compounds as Inhibitor of Dengue Virus (DENV) NS2B/NS3 Protease from Sweet Potato (Ipomoea batatas L.) Leaves. Indian J Forensic Med Toxicol. 2020; 15(1): 1627–1632.
35. Ansori ANM, Kharisma VD, Fadholly A, Tacharina MR, Antonius Y, Parikesit AA. Severe Acute Respiratory Syndrome Coronavirus-2 Emergence and Its Treatment with Alternative Medicines: A Review. Research Journal of Pharmacy and Technology 2021; 14(10):5551-7.
36. Wahyuni DK, Ansori ANM, Vidiyanti F. GC-MS analysis of phytocomponents in methanolic extracts of leaf-derived callus of Justicia gendarussa Burm.f. Biosci Res. 2017;14(3):668-677.
37. Ansori ANM, Fadholly A, Hayaza S, Susilo RJK, Inayatillah B, Winarni D, Husen SA. A Review on Medicinal Properties of Mangosteen (Garcinia mangostana L.). Res J Pharm Techol. 2020; 13(2):974-982.
38. Kharisma VD, Agatha A, Ansori ANM, Widyananda MH, Rizky WC, Dings TGA, Derkho M, Lykasova I, Antonius Y, Rosadi I, Zainul R. Herbal combination from Moringa oleifera Lam. and Curcuma longa L. as SARS-CoV-2 antiviral via dual inhibitor pathway: A viroinformatics approach. J Pharmacogn Res. 2022; 10(1): 138-146.
39. Tacharina MR, Ansori ANM, Plumeriastuti H, Kusnoto , Kurnijasanti R, Hestianah EP. Beneficial effect of grinting grass (Cynodon dactylon) on the streptozotocin induced diabetes mellitus in the mice. Indian Vet J. 2020; 97(4): 35-38.
40. Husen SA, Setyawan MF, Syadzha MF, Susilo RJK, Hayaza S, Ansori ANM, Alamsjah MA, Ilmi ZN, Wulandari PAC, Pudjiastuti P, Awang P, Winarni D. A Novel Therapeutic effects of Sargassum ilicifolium Alginate and Okra (Abelmoschus esculentus) Pods extracts on Open wound healing process in Diabetic Mice. Research J. Pharm. and Tech. 2020; 13(6): 2764-2770.

GRAPHICAL ABSTRACT

Kirinyuh *(C. odorata. L)*



A phytochemical compound in *C. odorata* L.



Pharmacological activities of Kirinyuh leaf extract (*C. odorata* L.)

ABOUT AUTHORS

Rahadian Zainul has completed a Bachelor of Educational Chemistry in IKIP Padang, then continued his studies and obtained a Master of Chemistry at Universitas Andalas, and earned a Doctoral Chemistry degree at Universitas Andalas. He is a researcher on the design and modification of copper oxide for inactivation SARS-CoV-2 by stimulated indoor lights and a researcher on the design and modification of copper oxide by computation approach with DFTB+. He is also the Head of Cambiotics Research Center, Universitas Negeri Padang. The author has published 41 manuscripts in Scopus-indexed journals and also 8 h-index.

Cite this article: Harfiani E, Nugraha Y, Aprilia CA, Makkiyah FA, Puspita R, Kharisma VD, et al. The phytochemical and pharmacological activity of extract Kirinyuh (*Chromolaena odorata* L.) leaves: A Review. Pharmacogn J. 2022;12(5): 580-586.