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Studies on the Benefits of Cogon Grass (*Imperata cylindrica* L) in Indonesia: A Review

¹Mohammad Kanedi, ²Endah Setyaningrum, ³Kusuma Handyani, ⁴Wawan Abdullah Setiawan
^{1, 2, 3, 4}Department of Biology, Faculty of Mathematics and Sciences, University of Lampung, Bandar Lampung, Indonesia

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Corresponding Author: **Mohammad Kanedi**

Abstract

Cogon grass (*Imperata cylindrica* L.) is one of the most invasive weeds in the world which causes many losses in agriculture and plantations. To find added value from cogon grass, in many countries in the world, including Indonesia, various studies have been carried out on the aspects that can be utilized from this grass. In this article, the results of a study of published research articles on cogon grass that have been carried out in Indonesia by Indonesian researchers are

presented. The results showed that there were at least 48 research articles on the cogon grass found. There are five benefits of cogon grass were found, namely as a source of allelopathic ingredients for weed control, a source of pharmacological medicinal ingredients, general health maintenance ingredients, a source of animal feed, and a source of energy.

Keywords: Cogon Grass, Ilalang, *Imperata cylindrica*, Allelopathic Effect, Pharmacologic Properties

1. Introduction

Cogon grass (*Imperata cylindrica* (L.) P. Beauv.) Is one of the world's most problematic invasive plant in the world, especially in the tropical and subtropical region ^[1, 2]. In Indonesia this grass also has troublesome effect in agriculture, causing great loss in crop production ^[3]. In this country, the grass was found in every main island such as Sumatra, Java, Borneo, Celebes, Moluccas, and Papua ^[4]. The invasive nature of cogon grass is related to its spread through the wind and the plant's high content of allelopathic substances which can inhibit the growth of other plants ^[5].

The widespread distribution of cogon grass in the world and the high level of damage it causes to agriculture have made this plant much researched. The research carried out includes how to control the growth of this grass, what active substances contained, and how to use it in the agricultural, husbandry and pharmaceutical fields.

Chemical research on cogon grass shows that the rhizomes of this plant contain several active compounds such as arundoin, cylindrin, fernenol, cylindol, cylindrene, graminones, imperanene. Impecyloside, 5-hydroxy-2-(2-phenylethyl) chromone, 5-hydroxy-2-[2-(2-hydroxyphenyl) ethyl] chromone, flidersiachromone, 5-hydroxy-2-styrylchromone. The aerial part of this plant contained triclin, jaceidin, daucosterol, Quercetagetin-3, 5, 6, 3'-tetramethyl ether, 3, 5-Di-O-methyl-kaempferol (26), β -Sitosterol-3-O- β -D-glucopyranosyl-6"- tetradecanoate, 3-Hydroxy-4-methoxy benzaldehyde, β -sitosterol, a-amyrin, and tabanone ^[6, 7].

The review article written by Nayim *et al.* (2023) stated that there has been a lot of research in the world on the pharmacological properties of cogon grass. Among them are the following: *I. cylindrica* potentiates as an antimicrobial activity, significant antihypertensive, anti-hyperglycemic, anti-parasitic, and antioxidant activity and non-toxic to humans by oral route ^[8].

In this article we present the results of research to find the benefits and added value of the invasive weed of cogon grass which has been carried out in Indonesia by Indonesian researchers.

2. Methodology

2.1 Search Strategy

Relevant literature searches were done online using the Google search engine. The targeted database is not limited based on its reputation, but rather the open access nature of the database in question. All open access databases that allow the full text to be downloaded are used in searches including PubMed, Science Direct, Web of Science, Semantic Scholar, PLOS ONE, MDPI,

JSTOR, Zenty, Zenodo, SCI, and Research Gate. The keyword used was as follows “ilalang” AND “cogon grass” AND “*Imperata cylindrica*” AND “herbicidal properties” AND “pharmaceutical properties” AND other words related to herbicides and pesticides such as “allelopathic properties” or “insecticidal properties”.

2.2 Inclusion Criteria

All papers presenting the results of study on the effect and uses of the active ingredients contained in the cogon grass plant were included in our search. The main paper inclusion criteria are published in a platform that can be accessed via

internet in Indonesia. The country area where the research is conducted and the institution where the researcher is affiliated are not taken into consideration. The year of publication of the work is also not used as a criterion for data compilation in this review.

3. Results and Discussion

There are at least 48 research articles about the properties of cogon grass plant contents that we managed to find and download. The brief descriptions of the materials and methods as well as the results of the research in each paper are presented in Table 1.

Table 1: Research results on the uses and benefits of cogon grass (*Imperata cylindrica*) in Indonesia

Plant part used	Preparation	Experiment	Effect	Ref.
Whole plant	Extract	Treatment of <i>Colletotrichum musae</i> isolated from fruit plant of Cavendish banana	Inhibit growth and sporulation of <i>C. musae</i> both in-vitro and in-vivo.	9
Whole plant	Ethanol extraction	Treatment of seedling of acacia	Allelopathic effect on acacia seedling	10
Rhizome	Water extraction	The extract sprayed on the weed	The extract has no effect on percent of weed coverage	11
Leaves	Water extraction	The extract is used to soak corn kernels	Decrease seedling and growth corn seed	12
Whole plant	Methanol extraction	The extract sprayed on the weed	Suppression of weed's height and stem diameter	13
Whole plant	Water extraction	Extract was sprayed on cucumber field	Inhibit growth of weeds and enhance cucumber fruit	14
Leaves	Water extraction	The extract is mixed with oyster mushroom growing medium	Inhibit growth of <i>Trichoderma viridae</i> , the common disease of the mushroom	15
Whole plant	Water extraction	The extract is given to the soil of cayenne pepper plants	The extract suppresses the growth of cayenne pepper	16
Whole plant	Ethanol extraction	The extract is mixed to the soil of palm oil seedling	Decrease wet and dry weight of oil palm sprouts	17
Rhizome	Water extraction	Extract sprayed on the bandotan weed	Decrease plant height and leaf number of bandotan weed	18
Whole plant	Ethanol extraction	The extract is sprayed on onion plants	No inhibition effect are shown	19
Whole plant	Water extraction	Spinach seeds <i>Amaranthus spinosus</i> L soaked in extract	Growth inhibition of spinach seedling	20
Whole plant	Water extraction	Weed of <i>Ageratum conyzoides</i> , <i>Eleusine indica</i> , and <i>Cyperus rotundus</i> L	Inhibit growth of <i>Ageratum conyzoides</i> , <i>Eleusine indica</i> , and <i>Cyperus rotundus</i> L.	21
Whole plant	Mulch of the plant	Mulch given to the field of corn	Mulch of cogon grass inhibit weeds growth and enhance corn production	22
Rhizome	Rhizome implant	Rhizome of cogon grass compete green bean seedling	Growth and yield of green beans decreased with the increasing number of rhizome	23
Rhizome	Methanol extraction	Extract given to soil of weed plant of <i>Cleome ruidosperma</i>	Cogon grass extract inhibited the growth of the purple cleome	24
Rhizome	Water extraction	The extract is added to the weed plant media	Rhizome extract of the cogon grass inhibit growth of the weeds	25
Whole plant	Ethanol extraction	Bioactive component analyzed using GC-MS	Three fungicide substances found: 2-Ethyl-1-hexanol, 1-Hexanol, 2-ethyl-, and 2-Propyl-1-pentanol.	26
Whole plant	Rhizome boiled	Boiled water is used for treatment	Cogon grass extract is anticancer, treat fever and jaundice	27
Whole plant	Ethanol extraction	Extract given orally to the rats. Kidney Histopathology of the rats analyzed.	Cogon grass extract reverse urolithiasis of kidney in rats	28
Whole plant	Ethanol extract	Extract was used to soluble kidney stones	The extract dissolving kidney stone calcium in vitro	29
Rhizome	Ethanol extraction	The extract was analyzed for total phenol, flavonoid, and DPPH radical scavenging activity and IC50	The extract yield was 14.13%, total phenolic was 129.57 mgGAE/g extract, total flavonoid was 90.91 mgQE/g extract and antioxidant activity was 56.03% with the IC50 value 0.098 mg/m	30
Rhizome	Grass was chopped and fermented with sugar	The kombucha then tested for DPPH radical scavenging activity and it antidiabetic in alloxan induced mice	The kombucha has strong antioxidant activity and antidiabetic potentials.	31
Rhizome	Methanol extraction	Extract was tested for it antioxidant using thiocyanate method	Extract able to damp free radical activity	32
Whole plant	Ethanol and ethyl acetic extraction	Extract is given to rat feed on high cholesterol diet	Extract has hypocholesterolemic and antioxidant effects	33
Rhizome	Ethanol extraction	Extract given to the carrageenan induced paw edema male rats	Extract of cogon grass has anti inflammation properties in rats	34
Whole plant	Patch preparation made from ethanol	The patch give to the rats induced with DPT vaccine	Ethanol extract of cogon grass can reduce body temperature	35

	extract of the grass			
Rhizome	Methanol extraction	Extract given to white rat induced with vaccine	Extract lowered body temperature similar to paracetamol 200 mg/kg BW	36
Rhizome	Ethanol extraction	Infra red (IR) plantar test method done on mice	Extract of cogon grass able to withstand pain in mice	37
Leaves	Methanol extraction	The extract was screened for flavonoid, phenolic, and steroid and tested for its IC ₅₀ values.	Extract of cogon grass leaves has antiinflammation activity.	38
Leaves	Methanol extraction	Extract was screened for its phytochemicals and antiinflammatory activity	Extract contained flavonoids, Phenolics and steroids. Antiinflammatory test showed IC ₅₀ values of 125.937ppm.	39
Leaves	Extracted to find out secondary metabolites	The secondary metabolites tested for its antibacterial effects	Extract inhibit <i>Escherichia coli</i> and <i>Staphylococcus aureus</i>	40
Whole plant	Cogon grass was made as straw	The straw is soaked and the water used as attractant for <i>Aedes</i> mosquitoes to lay their eggs	Attractant made from straw of cogon grass effective in attracting <i>Aedes</i> mosquito to lay eggs.	41
Rhizome	Ethanol extraction	Extract used to treat 3 rd instar of <i>Aedes</i> larvae	The extract killed the mosquito larvae with an LC ₅₀ values of 0.2116%	42
Rhizome	Water extraction	Hands of volunteers were sprayed with the extract. Before and after treatment, the microbial content on the hands was checked.	There is no significant effect of the sanitizer on the number of microbes on volunteer's hand.	43
Whole plant	Ethanol extract	Extract given to DDY strain mice for 14 days	Extract causes tailless, folded and bent sperm of mice.	44
Rhizome	Ethanol extraction	Extract given to shaved male rats	There is no significant effect of the extract on the growth of the hair.	45
Rhizome	Ethanol extraction	Extract given to male mice and mated with virgin female	There was a decrease in the number of fetuses, fetal weight and length of mice.	46
Rhizome	Crude extract	Extract given to the male mice to see its effect on white blood cells	The extract cause a greater count of leukocytes, increased the humoral antibody titer value and relative spleen weight	47
Rhizome	Ethanol extraction	Extract given to DDY strain mice for 14 days	Sperm motility and sperm with normal morphology increased following dose pattern, compared to control (p<0.05). Cogon grass root ethanol extract cannot maintain optimum epididymal sperm quality in old mice.	48
Rhizome	Rhizomes are boiled	Extract given to male that were mated with virgin female	Extract of <i>Imperata cylindrica</i> increases the stamina of male mice.	49
Rhizome	Ethanol extraction	Extract given to male mice of DDY strain	Extract made increased of body weight but lowering sexual organ weight.	50
Rhizome	Extract	The extract is used as an ingredient in making edible coating for grapes	Edible coating effective in keeping grapes quality	51
Whole plant	Cellulose extracted from cogon grass by delignification	Cellulose then used as granule and tablet of Paracetamol	Cogon grass cellulose could be used as a partial substitute for Avicel PH 101	52
Whole plant	The grass was chopped and fermented using local microorganism	Fermented feed given to the <i>Bubalus bubalis</i> Linn.	The fermented cogon grass decrease in pH, increase in protein and reduce the content of gauze fiber	53
Whole plant	Chopped reeds of the cogon grass are mixed with starch and pressed	The briquettes formed are tested for combustion	Initial ignition time 3.23-4.46 minutes, combustion duration 13.14-17.50 minutes and speed of combustion is 1.029-1.370 g/minute	54
Whole plant	Liquid smoke is made by pyrolysis at 400°C.	Liquid smoke was analyzed for phenol content, acid content, pH, and antifungal capabilities <i>in vitro</i>	The phenol content of cogon grass liquid smoke is 46-86 µg GAE/mL, acid is 3.21-5.48%, pH ranges from 2-3, and is antifungal.	55
Whole plant	Fixed bed pyrolysis was done	Bio-oil found were analyzed for thermo gravimetric analysis, proximate analysis, elemental analysis, compositional analysis, calorific value.	The calorific value of cogon grass is 18.05 MJ/kg calories, low ash content and high volatile content. The main components in bio-oil are furan, ketone, phenol and anhydro sugar which can be converted into energy.	56

Based on the data in Table 1, cogon grass research was carried out by researchers from the following fields of study: Agriculture, pharmacy, health science, food science, animal husbandry, environmental science, and alternative energy. The results of studies on aspects of agricultural science found that cogon grass contains various active ingredients that affect the growth of other plants so that it has the potential to be a plant growth regulator [14, 22]. The most

research states that cogon grass contains allelopathic substances that can inhibit other plants [10, 12, 13]. The allelopathic properties of cogon grass are also seen in the fungi *Colletotrichum musae* and *Trichoderma viridae* [9, 15, 26]. Test results on weeds show that cogon grass plant extracts have inhibitory abilities against the weeds *Ageratum conyzoides*, *Eleusine indica*, *Cyperus rotundus* L and *Cleome rutidosperma* [22, 23-25].

The results of pharmaceutical studies of cogon grass show that cogon grass extract has the following properties: Anticancer [27], antilithiasis [28-29], antioxidant [30-33], antipyretic [35-36], analgesic [37], anti-inflammatory [38-39], antilarvae [41-42]. In other studies, related to health, cogon grass extract is known to reduce male fertility [44, 46], increase antibodies [47], increase male stamina [49], and increase body weight [50].

In the aspect of food science, cogon grass extract is known to contain cellulose which can be used for edible coating on grapes [51] as well as granules and medicinal tablets [52]. From animal husbandry studies, it is known that cogon grass extract can be used as feed for swamp buffalo (*Bubalus bubalis*) [53].

Furthermore, from an environmental science perspective, it is known that cogon grass material can be used as briquettes for home stoves [54]. Cogon grass material can also be pyrolyzed to obtain liquid smoke which can be used for various purposes such as medicinal ingredients [55]. Cogon grass extract can also be used as bio-oil which is rich in furans, ketones, phenol and anhydro sugar which can be converted into an energy source [56].

So far, the potential benefits of cogon grass that have been most researched in Indonesia are its anti-weed properties and pharmacological properties. The anti-weed properties of cogon grass are natural because this grass plant has succeeded in revealing the presence of compounds that can be allelopathic in other plants. The allelopathic substances are: Gallic acid, caffeic acid, salicylic acid, sinapinic acid, benzoic acid, cinnamic acid, emodin, ferulic acid, 4-hydroxyphenylacetic acid, chlorogenic acid, resorcinol [57]. The pharmacological effects of cogon grass are also normal because this highly invasive weed is rich in active ingredients. There are at least 72 active substances consisting of 16 types of saponin compounds, 20 types of flavonoid compounds, 6 types of glycosides, 18 types of phenol compounds, 3 types of coumarin compounds and 9 other types of compounds [58].

4. Conclusion

Based on the results of research conducted in Indonesia, at least five benefits of cogon grass were found, namely as a source of allelopathic ingredients for weed control, a source of pharmacological medicinal ingredients, general health maintenance ingredients, a source of animal feed, and a source of energy.

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6. Conflict of Interest

Authors declare there is no conflict of interest.

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