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Pharmacological Potential Of Vernonia Amygdalina With Various Bioactive Compounds: A Review

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ABSTRACT
Indonesia, as a megadiverse country has a wealth of tropical plants which are used in traditional medicine, including Vernonia amygdalina Del. or African leaves, which are known to have various pharmacological properties. This plant contains bioactive compounds such as flavonoids, alkaloids, and saponins, which have the potential to be used as an effective alternative herbal treatment. The aim of this literature study is to explore the pharmacological potential of Vernonia amygdalina Del. (African leaves) as a medicinal plant rich in bioactive compounds. This research method was carried out using a Systematic Literature Review (SLR). The result of researchs related to Vernonia amygdalina pharmacological potential and its bioactive compound was extracted from research article that published in Indonesia on 2018-2024. Based on research on previous studies, it was found that the pharmacological effects of African leaves (Vernonia amygdalina) include antioxidants which show moderate antioxidant activity with an IC50 value of 107,839 ppm, antibacterial containing flavonoids, tannins, saponins, and alkaloids which have antibacterial activity, antihyperlipidemia which has been proven to be effective in increases HDL levels in mice and reduces free cholesterol, especially at high doses comparable to simvastatin, anticancer which has anticancer potential with strong cytotoxic activity against WiDr cells, and anti-diabetic which can increase pancreatic cell regeneration and reduce blood glucose levels. Based on a literature review, it can be concluded that African Leaf extract (Vernonia amygdalina) contains various bioactive compounds that have potential as antioxidant, antibacterial, anti-cholesterol, anticancer, and anti-diabetic agents.

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INTRODUCTION

Various types of tropical plants are found in Indonesia, one of the countries with the largest megadiversity. People have used various plants for traditional medicine. African leaves (*Vernonia amygdalina Del.*) are one of the medicinal plants found in East Kalimantan. Widely used as green vegetables or herbs for traditional medicine (Mashunah, 2020). For centuries, members of the asteraceae family have been used in food and medicine. There are over 25,000 species and 1600 genera of this family worldwide. African leaf (Vernonia

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amygdalina Delile) is one example of a plant from the asteraceae family that has long been studied and has various pharmacological effects (Yesika, 2023).

African Leaf Image
(https://images.app.goo.gl/xthSNR7aFpCSDXU8A)

Vernonia amygdalina is a shrub that originates from the African continent and several other countries in Africa, especially tropical countries such as Nigeria, Cameroon, and Zimbabwe. This plant can be found in yards, along rivers and lakes, on forest edges, and in grasslands. They can be planted in all types of land, from the coast to mountaintops. People in Kalimantan and Malaysia call this plant "Daun Bismillah". They also call it "Daun Africa" in Indonesian and "Bitter Leaf" in English (Mandey, 2020). African leaf plant, also known as *Vernonia amygdalina Del*., is a soft woody plant or shrub from the Asteraceae family and the genus Vernonia. Because its population is concentrated in the African continent, this plant is called the African leaf plant. The leaves are often called the African bitter leaf plant because of its bitter taste. The bitter taste found in the leaves is caused by secondary metabolites such as alkaloids, saponins, tannins, and glycosides. This plant is classified as a perennial plant and has been widely studied to explore its benefits as a herbal medicine (Maris, 2019).

Medicinal plants are plants that have substances in one or more parts that function as medicine. Many recent discoveries of natural medicines that can cure diseases have encouraged the growth of home remedies in Indonesia. Compared to synthetic drugs, natural medicines help and repair tissue and rebuild cell capabilities (Murjianingsih et al., 2019). Traditional medicine is a concoction or ingredient that has been used for generations for medicinal purposes, including ingredients from plants, animals, minerals, galenic preparations, or a combination of these ingredients (Dumanauw, 2020).

Before the era of modern medicine, plants have been used in traditional medicine for centuries. African leaf (*Vernonia amygdalina Del*) is one example of a “back to nature” approach, demonstrating the potential of plants to enhance the benefits of natural medicine (Wirassti, 2021). Several studies have found various groups of bioactive compounds in this plant, indicating that V. amygdalina has a variety of pharmacological benefits that support its use as an alternative herbal medicine (Bestari, R., 2021).

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African leaves (*V. amygdalina*) are known to have various pharmacological properties, such as antimicrobial, antimalarial, antioxidant, antidiabetic, antiallergic, and antibacterial. These various pharmacological activities are associated with the content of complex bioactive compounds. V. amygdalina contains tannins, anthraquinones, flavonoids, alkaloids, saponins, and glycosides (Nweke Elizabeth, 2019). Research on *V. amygdalina* shows that this plant contains various bioactive compounds, including saponins, flavonoids, tannins, alkaloids, phenolics, steroid glycosides, terpenes, triterpenoids, and sesquiterpene lactones. In addition, proteins, fats, fibers, amino acids, vitamins, minerals, and carbohydrates were also found in it (Bestari, R., 2021).

METHOD

This study was conducted by reviewing scientific journals from National Journal sources indexed by Google Scholar, using keywords such as "Vernonia amygdalina," "Antioxidant," "Antibacterial," "Antikolesterol," "Antikanker," and "Antidiabetes." A total of 24 primary articles were selected based on inclusion criteria that included studies on antioxidant, antibacterial, anticholesterol, anticancer, and antidiabetes activity tests in the 2019-2024 period. Articles that only discussed Vernonia amygdalina without data related to antioxidant, antibacterial, anticholesterol, anticancer, and antidiabetes activities were excluded. The results obtained were then presented in tabular form.

RESULTS

Antioxidant

Antioxidant have the ability to prevent or delay the formation of free radicals in the lipid oxidation process (Sila, M. D., 2020). Antioxidant do a lot to protect the body from free radicals because they bind to free radicals and highly reactive molecules, which prevents cell damage (Kusuma, A. E., 2022).

No.	Researcher's Name and Year	Title	Result
1.	Ramadhan Bestari, 2021.	Phytochemical Compounds and Pharmacological Activities of African Leaves (*Vernonia amygdalina Del.*)	Using organic solvents, extraction has shown that various flavonoids can be extracted from these leaves. These include luteolin, luteolin 7-O-β-glucuronoside, and lutelin 7-O-β-glucoside. Specifically, luteolin exhibits remarkable antioxidant activity, even more than butyl hydroxy toluene. Research using the DPPH method showed that levels of endogenous antioxidant enzymes such as glutathione, catalase, and superoxide dismutase increased with the administration of the extract, while MDA levels decreased.

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No.	Researcher's Name and Year	Title	Result
2.	Ramadhan Bestari, 2021.	Phytochemical Compounds and Pharmacological Activities of African Leaves (*Vernonia amygdalina Del.*)	In "in vivo biochemical studies", *V. amygdalina* extract increased the levels of endogenous antioxidant enzymes such as glutathione, catalase, and superoxide dismutase while decreasing MDA levels in mice. In addition, the extract showed chemopreventive effects by reducing lipid profiles and stopping lipid peroxidation and β-carotene bleaching. Thus, the potential of V. amygdalina as a source of antioxidants allows the development of therapies to overcome oxidative damage and diseases associated with it. The results of the study using the ABTS method showed that the flavonoid content in the extract has chemopreventive properties by reducing lipid profiles and preventing β-carotene bleaching and lipid peroxidation.
3.	Susi Yanuari Mustikasari, Ignatius Hapsoro Wirandoko, dan Ika Komala, 2020.	Effectiveness of African Leaf Extract (*Vernonia Amygdalina*) on Epithelialization Thickness in Mice Wounds.	The results of the study showed that the flavonoid, tannin, and saponin content in African leaves affected wound healing. Researchers used African leaf extract on mouse wounds and found that it increased the thickness of epithelialization. This shows that the flavonoid, tannin, and saponin content, which are compounds that have active properties, so that those who received African leaf extract at doses of 11% and 13% showed increased tissue regeneration. This proves that the compounds in African leaf extract act as antioxidants.
4.	Halimatussa'diyah, Eem Maesanah, dan Dea Anisa Putri, 2024.	Antioxidant Activity Testing of Ethanol Extract of African Leaves (*Gymnathemum amygdalinum Del.*) Using the DPPH Method on Liquid Bath Soap Preparations.	According to research, the IC50 value of African leaf ethanol extract is 107.839 ppm, which is included in the moderate antioxidant group with a value range of 101-150 ppm.
5.	Brigita Daturara, Bida	Effectiveness Test of	The study showed that all groups

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No.	Researcher's Name and Year	Title	Result
	Cincin Kirana, dan Christina Indriasari, 2024.	African Leaf Extract (*Vernonia amygdalina*) on Wound Healing.	experienced a wound healing process. Compared with the treatment group and positive control group given African leaf extract, the negative control group that received a 0.5% CMC Na solution application experienced slower healing. On the 14th day, the wounds in both the treatment group and the positive control group had completely closed, although they still looked slightly reddish.

Secondary metabolites in African leaf extract, such as saponins, flavonoids, alkaloids, and tannins, play a role in accelerating the wound healing process. Flavonoids, with their anti-inflammatory properties, support the proliferation phase by accelerating epithelialization and reducing inflammation, so that the wound healing process takes place faster (Irawan et al.,2023).

In addition to functioning as antioxidants, flavonoids are also able to fight free radicals. These free radicals can interfere with the inflammatory process, inhibit cell proliferation, and block the contraction of collagen tissue that is formed, thus slowing down the wound healing process (Purnomo et al., 2021). Tannins have antimicrobial and antioxidant properties, which speed up wound healing (Budiawan et al.,2023). Saponins also have wound healing, antibacterial, and antiseptic properties (Hakim et al., 2021). Alkaloids and other antimicrobial drugs prevent microbes from multiplying in the wound (Priamsari & Yuniawari, 2019). In addition, alkaloids have analgesic and anti-inflammatory properties that can help relieve pain from wounds (Adam & Widjiati, 2022).

Antibacterial

Antibiotics are substances that can kill bacteria or inhibit their growth and reproduction (Iklila Zahra, 2021). Compounds found in African leaves (Vernonia amygdalina Del) contain antibacterial substances in the form of flavonoids, saponins, tannins, alkaloids, steroids and triterpenoids. These compounds exert antimicrobial effects through various mechanisms.

A wound is tissue damage to a part of the body caused by a knife, razor, or other sharp object. Wound healing itself is the process of restoring the function of tissue damaged due to trauma or injury. Wound healing consists of four stages, namely the homeostatic stage, the inflammatory stage, the proliferation stage, and the masturbation or remodeling stage (Brigita Daturara, 2024).

No.	Researcher's Name and Year	Title	Result
1.	Trifosa Permata Dewani Sarijowan,	African Leaf Extra Anibacterial Activity Test Against the Growth of Staphylococcus aureus and	The research results showed that the higher the extract concentration of Flavonoids, Tannins, Steroids, the greater the inhibition zone against Pseudomonas aeruginosa and

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No.	Researcher's Name and Year	Title	Result
	2022.	Pseudomonas aeruginosa Bacteria.	Staphylococcus aureus, indicating increased activity antibacterial. Extract shows the effect was strong at concentrations of 20%, 40%, and 80%, while at 5% and 10% it was still moderate. Infections caused by Pseudomonas aeruginosa often occur in patients with weak immune systems and can causes pneumonia and wound infections, while Staphylococcus aureus can cause infection skin to sepsis. this compound has the potential to be developed as antibacterial agent to treat nosocomial infections that are difficult to treat.
2.	Iklila Zahra, 2021.	Testing The Antibacterial Activity of African Leaf Ethanol Extract (*Vernonia Amygdalina Del.*) Against the Bacteria Escherichia Coli Atcc 25922 In Vitro.	The research results show that at a concentration of 20% content flavonoids, alkaloids, phenolics. zone the resistance is 7.48 ± 0.17 mm (weak), while in concentration The 0% inhibition zone reaches 11.67 ± 0.13 mm (medium). On concentration 60% formed an inhibition zone of 14.18 ± 0.21 mm (medium), and at 80% concentration increases to 16.60 ± 0.17 mm (strong). This matter indicates that activity antibacterial compound increases along with increasing concentration. Compound it can treat bacterial infections, including respiratory tract infections and skin. However, more research Further information is needed to find out Types of bacteria that can be treate.
3.	Rona Taufiqul Rachmanita, 2019	Effectiveness of Topical African Leaf Extract (*Vernonia amygdalina*) on Collagen Density in Healing Incision Wounds in White Rats (*Rattus norvegicus*).	Research shows that African leaf extract with content Flavonoids, Saponins, Alkaloids, potentially as an alternative wound healing, however further research is needed to determine do Panji Ratih Suci, 2024.sis right. Dose optimality is important to ensure effectiveness of internal extracts accelerates wound healing without causing side effects or toxicity. The compound found in African leaf extract may be useful in treatment various types of injuries, including cuts burns, surgical wounds, and diabetic wounds. In addition, this extract is also possible useful in treating infections wounds caused by bacteria pathogen. Further research will help understand the best way use this extract in

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No.	Researcher's Name and Year	Title	Result
			clinical practice to be sure safety and efficacy in wound healing.
4.	Panji Ratih Suci, 2024.	Effectiveness of African Leaf Extract Hand Soap (*Vernonia amygdalina Del.*) Against Escherichia coli bacteria	The research results showed that the extract African leaves with ingredients Flavonoids, Saponins, Alkaloids, inhibits the growth of E. coli at concentrations of 0.5%, 1%, and 2%, with their respective inhibition zones 2.93mm, 3.5mm, and 3.02mm. Liquid soap preparations containing This extract also shows efficacy good with inhibition zone of 3.40 mm, 3.93 mm, and 3.53 mmm. This compound has potential used to treat infections caused by E. coli, such as urinary tract infections and diarrhea.

Anti-cholesterol

Anticholesterol refers to the ability of a compound to lower cholesterol levels in the body. This compound is often found in various plants, including African leaves (Vernonia amygdalina), which are known to have positive effects on cholesterol levels (Elfia, 2024).

No.	Researcher's Name and Year	Title	Result
1.	Yuwarditra, Y., dkk. 2021	Comparison of the Effectiveness of Ethanol Extract of African Leaves (*Vernonia Amygdalina Del.*) With Simvastatin on HDL Levels in Male Wistar Rats Induced by Egg Yolk.	The results of the study showed that: • In mice induced by egg yolk, administration of 200 mg/kgBW/day of African leaf ethanol extract containing Saponin, Flavonoid Glycosides, Tannin, Triterpenoid, can increase HDL levels. • In mice induced by egg yolk, administration of 200 mg/kgBW/day of African leaf ethanol extract and 1 mg/kgBW/day of simvastatin successfully increased HDL levels effectively. • Administration of 1 mg/kgBW/day of simvastatin and 200 mg/kgBW/day of African leaf ethanol extract can increase HDL levels induced by egg yolk, but the effectiveness between simvastatin and African leaf ethanol extract does not differ significantly.
2.	Bella, 2022	Anticholesterol Activity Test of Combination of African Leaf	The combination of ethanol extract of African leaves and pine leaves with flavonoid

		Extract (*Vernonia Amygdalina*) and Pine Leaf Extract (Pinus Merkusii) In Vitro.	content showed significant anticholesterol activity with the ability to reduce free cholesterol levels in samples. At a concentration of 50 ppm, this combination was able to reduce free cholesterol by 5.41%, and at a concentration of 150 ppm, the reduction increased to 21.29%. This suggests that bioactive compounds in African leaves and pine, such as flavonoids and phenolics, contribute to lowering cholesterol by inhibiting cholesterol-forming enzymes or increasing cholesterol metabolism. This effect is relevant in efforts to control cholesterol and prevent the risk of cardiovascular disease.
3..	Sari, 2020	Anticholesterol Effectiveness Test of Combination of Ethanol Extract of African Leaves (*Gymnanthemum Amygdalina Del.*) With Ethanol Extract of Oil Palm Leaves (Elaeis Guineensis Jacq.) In Hypercholesterol Rats.	Ethanol extract dose with flavonoid content of 400-600 mg/kgBW showed optimal effectiveness comparable to simvastatin, a commonly used cholesterol-lowering drug. This effectiveness indicates that at high doses, bioactive compounds in the extract such as flavonoids can inhibit key enzymes in cholesterol synthesis (HMG-CoA reductase), similar to the mechanism of action of simvastatin. Thus, the extract at high doses has the potential to be a powerful natural alternative in lowering cholesterol levels, while reducing the risk of cardiovascular disease.

Anticancer

Cancer is a malignancy that occurs in body tissues, where abnormal cells grow excessively and in an uncoordinated manner. The main issue with cancer is the cells' ability to utilize epigenetic properties in the continuous growth and spread of abnormal cells, leading to uncontrolled cell proliferation. The main issue with cancer is the cells' ability to utilize epigenetic properties in the continuous growth and spread of abnormal cells, leading to uncontrolled cell proliferation (Agustin, 2020). Anticancer refers to drugs used to prevent and treat the growth of abnormal tissue cells, while cancer is a disease caused by the growth of abnormal tissue cells (Maningkas, 2019).

One of the causes of cancer is free radicals that attack human body cells. Free radicals are suspected to be the cause of cell damage underlying the development of cancer, resulting in oxidative stress in humans. Antioxidants are compounds that can reduce oxidative stress. Antioxidant activity is closely related to anticancer activity (Larasati, 2023).

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No.	Researcher's Name and Year	Title	Result
1.	Nadhira, 2019	Cytotoxic Activity of Methanol Extract of African Leaves (*Vernonia Amygdalina Delile*) on HeLa and WiDr Cells.	The results of EEADA (Ethanoic Extract of African Leaves) containing flavonoids, glycosides, saponins, terpenoids/steroids, show potential as an anticancer agent due to its strong cytotoxic activity against WiDr cells. It inhibits the cell cycle at the G2-M phase, induces apoptosis, and modulates the expression of apoptosis-related proteins, such as suppressing COX-2 and increasing cleaved caspase-3.
2.	Gaffar, 2022	Antioxidant and Cytotoxic Activity of Vernonia amygdalina (Asteraceae) Leaf Extract on HeLa Cancer Cells.	The results of the IC50 (Inhibitory Concentration 50) value for the methanol extract containing alkaloids, flavonoids, steroids, and triterpenoids were reported to be around 21.72 µg/mL. This indicates that these compounds have potential as antioxidant agents for developing therapy for HeLa cancer cells.

Antidiabetic

The group of metabolic disorders known as diabetes mellitus is characterized by hyperglycemia, one of which is caused by anomalies in insulin secretion. According to Muhammad Puput As'ari (2021), chronic hyperglycemia in diabetes is associated with long-term dangers and dysfunction in a number of body organs, especially the heart, kidneys, eyes, nerves, and blood vessels.

A chronic disease known as diabetes mellitus is caused by high blood glucose levels, which are caused by insufficient or inadequate insulin production by the body. If a person's blood glucose level is 126 mg/dL or higher while fasting and 200 mg/dL two hours after eating, they are diagnosed with diabetes (Ika Novita Wardani Kitu, 2020).

No.	Researcher's Name and Year	Title	Result
1.	Kitu, I.N.W., dkk. 2020	Activity of Ethanol Extract of African Leaves (*Vernonia Amygdalina Del.*) on Blood Glucose Levels of White Rats (*Rattus Norvegicus*).	The results showed that at a dose of 400 mg/200 g bb, ethanol extract of African leaves (Vernonia amydalina Del.) with Flavonoid, Sapanonin, Steroid, Tannin content has antidiabetic effects. This information serves as a guide for future studies on ethanol extract of African leaves.
2.	As'ari, M. P., dkk. 2021	Test of African Leaf Infusion Activity (*Vernonia Amygdalina Delile*) as Antidiabetic in Balb/C Strain Mice (*Mus Musculus*)	Based on the research that has been completed, it can be concluded that African Leaf infusion with Flavonoid, Sapanonin, Tannin, Alkaloid content can affect blood sugar levels in animal rats involved in alloxan.
3.	Tandi, J., dkk.	Potential of Ethanol Extract of	The results showed that after consuming

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No.	Researcher's Name and Year	Title	Result
	2019	African Leaves (*Gymnanthemum amygdalinum (Delile) Sch. Bip, Ex walp*) on Reducing Blood Glucose Levels and Pancreatic Histopathology of Male White Rats (Rattus norvegicus) Induced by Streptocotocin and High Fat Feed.	150 mg of African Leaf Ethanol Extract with Flavonoid, Sapanonin, Tannin, Alkaloid, Steroid content had an average score of 0.8 and affected pancreatic cell regeneration. This is because a dose of 150 mg can rebuild β cells in the pancreas and restore normal blood glucose levels by penetrating the mouse pancreatic cell membrane.
4.	Daryanti, A., dkk. 2022.	Nanoemulsion Formulation of Purified African Leaf Extract (*Vernonia amygdalina*) Incorporated in Dissolved Microneedle Patch.	It has been proven that African leaves (Vernonia amygdalina) with the compound 11β,13-dihydrovernolide can lower blood sugar levels. The blood glucose levels of mice decreased in the specified group during in vivo testing, making the African Leaf Nanoemulsion Isolate Microneedle Patch.

CONCLUSION

Berdasarkan kajian literatur dari berbagai penelitian terkait ekstrak Daun Afrika (Vernonia amygdalina), dapat disimpulkan bahwa Daun Afrika (Vernonia amygdalina) memiliki kandungan senyawa Antioksidan (Flavonoid, Tannin, Saponin), Antibakteri (Flavonoid, Tanin, Steroid, Alkaloid, Fenolik), Antikolesterol (Saponin, Flavonoid Glikosida, Tannin, Triterpenoid,), Antikanker (Flavonoid, Glikosida, Saponin, Terpenoid/Steroid, Alkaloid) dan Antidiabetes (Flavonoid, Sapanonin, Tanin, Alkaloid, Steroid).

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