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Vernonia amygdalina Del (Bitter leaf) a traditional anti-diabetic gold mine - Mini Review

Peter Achunike Akah

Natural Products Research Unit, Department of Pharmacology and Toxicology, University of Nigeria, Nigeria.

ABSTRACT

Diabetes mellitus is a worldwide epidemic that has serious consequences for public health. This in-depth analysis of *Vernonia amygdalina*, or Bitter Leaf, aims to shed light on the plant's potential anti-diabetic properties by discussing its botanical description, chemical composition, traditional uses, and mechanisms of action, scientific findings, safety concerns, and implications for future study. *Vernonia amygdalina*, a plant native to various nations in Africa, has gained popularity as a possible treatment for diabetes. Bitter leaf's traditional function in reducing diabetes-related complications is also highlighted, and the review goes deeply into the plant's rich historical and cultural context. The possible anti-diabetic properties of Bitter leaf are discussed, along with the processes that may be at play. These include the effect on insulin sensitivity, glucose homeostasis, and pancreatic beta cell activity. Improving glycemic control and insulin resistance is only two of the positive effects seen in clinical trials and research investigations. There is also discussion of precautions to take, including details on how this treatment could interact with standard drugs. The review continues by stressing the need for more study to fill up the gaps in our understanding and pave the path for the deliberate application of *Vernonia amygdalina* as an adjunctive method of diabetes care. This analysis of Bitter leaf's diabetes-fighting properties adds to the increasing body of information around diabetes natural treatments, opening up new lines of inquiry and possible therapeutic applications in the field.

Key words: *Vernonia amygdaina, diabetes mellitus, traditional uses, mechanism of action*

INTRODUCTION

Chronic hyperglycemia due to abnormalities in insulin production or activity characterizes diabetes mellitus, which has become an unprecedented worldwide health crisis. Reports had it that 415 million people worldwide were diagnosed with diabetes in 2015, and this figure is expected to rise to 642 million by 2040.[1] Because of diabetes's complexity and the severity of its consequences, healthcare systems throughout the world confront enormous problems that need novel and all-encompassing methods of management and prevention.

There has been a recent uptick in the search for alternative treatments for diabetes, and one area of particular interest has been traditional medicinal plants. The plant, *Vernonia amygdalina* stands out as a promising option. Traditional African medicine has long acknowledged the potential anti-diabetic effects of Bitter leaf, a plant native to several African nations.

The urgent need for a thorough evaluation of the scientific evidence supporting the possible anti-diabetic properties of *V. amygdalina* is the impetus for this mini review. This review aims to contribute useful insights to the ongoing search for effective strategies in diabetes management by elucidating the botanical description, chemical composition, and historical usage, mechanisms of action, scientific findings, safety considerations, and implications of future research.

Address for correspondence:
Dr. Peter Achunike Akah
Natural Products Research Unit, Department of Pharmacology and Toxicology, University of Nigeria, Nigeria.
E-mail: peter.akah@unn.edu.ng

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The current state of diabetes calls for a coordinated effort to investigate innovative therapy routes, such as conventional, natural medicines. This work seeks to fill a void between conventional diabetic care and cutting-edge research by exploring *Vernonia amygdalina's* potential as an integrative therapy for the disease.

Search Methodology

An organized search was done in Web of Science, Scopus and Pub Med databases. The search focused on Bitter leaf and utilized various keywords such as *Vernonia amygdalina*, botanical description, cultural uses, historical usage, diabetes chemical composition, mechanism of action, and safety consideration. Articles that did not give information on biological activity relevant to diabetes were discarded

Botanical Description

The Asteraceae family, of which *V. amygd*alina is a member, is more popularly known as the daisy or sunflower family. Many different kinds of blooming plants belong to this family. An evergreen shrub or small tree, bitter leaf is a perennial plant. Its mature height is between 6.5 and 16.5 feet (2 to 5 metres).[2] A bushy look is typical of the plant because of its many stems and branches.

One of *V. amygdalina's* most recognizable characteristics is its leaves. They have no lobes, grow in pairs, and have very short petioles (stalks). The leaves have a serrated or toothed border and are lanceolate or elliptic in form.[3] The underside of the leaves is lighter green than the top. Several bioactive chemicals give the leaves their characteristically bitter flavor.

Small, composite blooms bloom in clusters atop inflorescences on Bitter leaf. The blooms have a tubular form and are often deep purple coloured. At the ends of the branches, they form thick clusters. The plant is hermaphroditic, meaning that both male and female reproductive structures can be found in the same flower. *V. amygdalina* produces a tiny achene, a dry, single-seeded fruit. Achenes often have a pappus, a bristly or hairy tuft that assists in wind dispersal. The seeds are little and feathery.

Typically, *V. amygdalina* have fibrous, shallow roots. Upper parts of the stem are herbaceous while lower parts are woody. The stem's colour and texture might vary, but it is often green or a ruddy brown with ribs. This botanical description offers a detailed account of the physical properties of *V. amygdalina*, which is highly prized for its cultural and medical importance as well as its ability to supply a number of beneficial bioactive chemicals.

Habitat and Distribution

Several nations in tropical Africa, including Nigeria, Ghana, Cameroon, and other areas of East Africa, are the ancestors of the *V. amygdalina*. It does well in a wide variety of environments, from woods and grasslands to gardens and farmland. It is prevalent in regions that receive a lot of rain each year. The leaves of the *V. amygdalina*, which are used for both food and medicine, are farmed as a crop. It thrives in both tropical and subtropical regions and may be propagated easily from seed or stem cuttings.[4]

Cultural and Historical Significance

The bitter leaf has deep historical and cultural importance in many African societies. For decades, it has been a staple of traditional medical practices, where it has been used to treat a wide variety of conditions, including diabetes.[5,6] The bitter flavor of the plant has been linked to its medical value, and it is commonly used in herbal medicines for its ability to alleviate diabetes-related symptoms.

Vernonia amygdalina has been used by traditional African healers for hundreds of years, as documented by both written and oral histories. The plant has a long history of traditional usage in Africa for the treatment of diabetes and other metabolic disorders.[7,8-10] Traditional uses of *V. amygdalina* for diabetes treatment give useful context, and scientific studies have tried to verify these folk claims.[7,11-13] Clinical studies and investigations into the processes through which Bitter leaf may have anti-diabetic benefits have been done.[13,14-16] The value of *V. amygdalina* as a potential resource for treating the worldwide diabetes burden is emphasized by the confluence of traditional knowledge with current scientific study. It is a model of how to combine traditional knowledge with scientific facts to create a comprehensive method for treating diabetes.

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Chemical Composition

Studies have focused heavily on *V. amygdalina*, because of its impressive chemical complexity and variety. Flavonoids, alkaloids, saponins, terpenoids, steroids, and phenolic compounds are some of the bioactive substances that have been identified in the leaf. Flavonoids, which are present in Bitter leaf, are a type of bioactive molecule that has been studied extensively because of its antioxidant and anti-inflammatory effects.[17-18] In addition to flavonoids. *Vernonia amygdalina* also contains alkaloids, which have gained notoriety for there possible anti-diabetic benefits. A number of biologically active compounds have been isolated and characterized from the leaves of *Vernonia amygdalina,* Notable among these compounds are vernoniosides D and E [19], vernoniosdies A_i, A_2, A_3, B_1[20] vernoniosides A_4, B_2, B_3 [21], vernodalin [22], vernomygdin [22], vernodalol [23-24], epivernodalol.[25] Other bioactive compounds isolated from the leaf of *Vernonia amygdalina* are luteolin, luteolin7-O-β-glucuronide and luteolin 7-O- β-glucoside.[26-27]

Vernonia amygdalina also contains a family of bioactive saponins[28] which have been shown to have hypoglycemic effects. Saponins may increase insulin secretion and boost glucose absorption by cells, resulting in better glycemic control. Additional benefits of *V. amygdalina* include its anti-inflammatory and antioxidant phenolic components.[29] It is possible that chemicals like chlorogenic acid and rutin found in *V. amygdalina* add value to its health benefits.

Mechanisms of Antidiabetic Action

Vernonia amygdalina has a promising anti-diabetic activity that has been studied scientifically. Based on available scientific studies, Bitter leaf has been shown to improve insulin sensitivity. This implies that it may help cells respond more efficiently to insulin, allowing for greater glucose absorption and utilization.[30]

V. amygdalina may aid to maintain stable blood glucose levels by modulating glucose homeostasis. This might be accomplished via regulating glucose synthesis in the liver or boosting glucose absorption in peripheral organs or by simultaneous suppression of gluconeogenesis and potentiating glucose oxidation via the pentose phosphate pathway.[31]

V. amygdalina has been studied for its ability to increase the function of pancreatic beta cells, which are responsible for insulin generation.[30] Improved beta cell activity can lead to more effective insulin secretion. There is also report that Bitter leaf increases the cell mass of the pancreas, enhancing proliferation of the β-cells of the pancreas [32], as well as regeneration of pancreatic beta cells.[33] Bitter leaf is also reported to protect the pancreatic β cells, increase insulin level, stimulate skeletal muscle glucose uptake and restore skeletal muscle glycogenesis.[30]

Some bioactive chemicals in *V. amygdalina*, including flavonoids and phenolic compounds, have antioxidant capabilities.[34-35] Antioxidants protect pancreatic beta cells from oxidative stress, which can be harmful in diabetes.[36] Chronic inflammation is linked to insulin resistance and diabetes. *V. amygdalina* 's anti-inflammatory components may contribute to its anti-diabetic properties by lowering inflammation.[18,37] *V. amygdalina* has been demonstrated to reduce blood glucose levels, which is an important part of diabetes care.[7] This can be accomplished through a variety of ways, including greater insulin sensitivity and higher glucose absorption. Studies have looked at how *V. amygdalina* interacts with insulin signaling pathways in cells, which are important for blood glucose management.[30] This interaction may help to increase insulin action. While there is encouraging evidence to support these pathways, further study is needed to completely understand how *V. amygdalina* exerts its anti-diabetic properties. Furthermore, individual reactions to Bitter leaf may vary, and its use as a supplementary therapy for diabetes should be done with caution and under medical supervision, especially if used in conjunction with standard antidiabetic drugs.

Safety and Adverse Effect Profile:

Vernonia amygdalina (Bitter leaf) has long been used traditionally for medical and nutritional purposes, although not much is known about its safety or toxicity. There have been studies, nevertheless, that look at its potential toxicity and safety issues.[38-42] Despite Bitter

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leaf's long history of safe usage in many different cultures, studies have raised serious safety concerns. *V. amygdalina* gets its name from its very bitter flavour. While this bitterness is a distinguishing attribute, it may not be accepted by everyone, and excessive intake may cause digestive discomfort, including nausea and stomach distress. [43] Bitter leaf's bitterness and chemical makeup might vary based on factors such as the plant's age, growth circumstances, and preparation techniques. This diversity may have influence on its safety and efficacy. Some people may be allergic to the substances present in Bitter leaf, resulting in allergic symptoms such as skin rashes, itching, or swelling. *V. amygdalina* may interfere with some drugs, particularly those used to treat diabetes.[44] It has the potential to enhance the effects of diabetes treatments, resulting in hypoglycemia.[45-47]

Some studies [40,42] have highlighted concerns regarding the potential hepatotoxicity linked with high dosages of Bitter leaf extracts. There has been no reported study on the safety of Bitter leaf during pregnancy and breast feeding, therefore it is best to speak with a healthcare expert before using it in these individuals. While *V. amygdalina* is historically thought to have diuretic effects that improve kidney health, patients with renal diseases should be aware of excessive fluid loss and electrolyte abnormalities. Cooking or processing *V. amygdalina* before intake might help decrease its bitterness and perhaps alleviate certain safety issues. Bitter leaf is frequently cooked with other ingredients in traditional cooking ways to achieve balanced flavours.

While *Vernonia amygdalina* (Bitter leaf) has proven possible health benefits in diabetes and is used traditionally in numerous cultures, it is critical to take caution and moderation when introducing it into diet or healthcare routine.

Recommendations

Further investigation into *V. amygdalina's* possible anti-diabetic effects is encouraged in the light of the findings reported in this review. To determine whether or not *V. amygdalina* is safe and effective as a diabetic treatment option, more extensive and well-controlled clinical trials are needed. Standardized treatment regimens require more study into the most effective dose and delivery method for *V. amygdalina*-based therapies. Moreover, academics, healthcare practitioners, and traditional healers should be encouraged to work together due to the rich historical and cultural value of *V. amygdalina* in traditional medicine. Such partnerships have the potential to improve diabetes treatment by incorporating cultural perspectives and traditional wisdom into contemporary evidence-based practices.

To further assure the safety of concurrent usage, it is important to investigate the potential interactions between *V. amygdalina* and traditional anti-diabetic drugs. In order to have fruitful talks with patients looking for complementary therapies for diabetes, healthcare providers should be aware of the available data and possible advantages of Bitter leaf.

Flavonoids, alkaloids, saponins, and phenolic compounds are some of the bioactive substances investigated in this overview. *V. amygdalina*'s traditional function in reducing diabetes-related complications is also highlighted, and the review goes deeply into the plant's rich historical and cultural context.

CONCLUSION

This analysis of *Vernonia amygdalina* (Bitter leaf's) botanical description, chemical makeup, traditional use, modes of action, and scientific studies reveals its possible anti-diabetic properties. Studies have shown that *V. amygdalina* can help with insulin sensitivity, glucose homeostasis, and glycemic control; therefore it may be useful as a natural treatment for diabetes. While there is some encouraging evidence that *V. amygdalina* may have anti-diabetic effects, it is important to note that more thorough and extended studies are needed to prove its efficacy and safety. However, the plant's deep cultural roots suggest it may be useful in a comprehensive strategy for controlling diabetes. Research into *Vernonia amygdalina* and other complementary medicines appears promising as the worldwide burden of diabetes rises. This review adds to the expanding body of information on diabetic

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natural treatments and highlights the need for more research into the therapeutic potential of *V. amygdalina* in the treatment and management of the disease.

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