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Dioscorea villosa in focus: A literature review of its traditional, phytochemistry, and pharmacological potential

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Abstract
Dioscorea villosa belongs to the family *Dioscorea*ceae. This genus includes more than 600 species distributed throughout Africa, Asia, the Caribbean, South America, and the South Pacific islands. Due to its appealing taste and nutritional value, it is widely utilized as a major source of carbohydrates and as a dietary supplement. Both the underground and aerial tubers provide essential proteins, fats, and vitamins to millions of people in West Africa. Traditionally, *Dioscorea villosa* has been employed in medicine for centuries to treat various ailments, and it remains an invaluable source of pharmaceuticals. Its traditional applications include managing rheumatoid arthritis, stomach and menstrual cramps, and gallstone pain. Additionally, potential medicinal uses of *Dioscorea villosa* encompass treatment for rheumatoid arthritis, menopause symptoms, diabetes, and muscle cramps. Preliminary phytochemical analyses have identified the presence of alkaloids, saponins, tannins, flavonoids, steroids, anthraquinones, and cardiac glycosides in the plant. These findings suggest that the contraceptive effects observed in female rats administered with ethanolic extracts of *Dioscorea villosa* tubers may be due to one or more of these compounds such as alkaloids, saponins, flavonoids, or cardiac glycosides which could exert their effects individually or synergistically. *Dioscorea villosa* exhibits various biological activities, including antioxidant, antimicrobial, anti-inflammatory, antiproliferative, androgenic, estrogenic, and contraceptive effects. Nevertheless, its ethnomedicinal potential requires validation through further research. Emphasis should be placed on pharmacological studies and phytochemical characterization, especially on translating preclinical findings into clinical efficacy.

Keywords: *Dioscorea*, traditional use, phytochemistry, pharmacological activities

Introduction
Human existence and survival heavily depend on the symbiotic relationship with plants and their derivatives, along with their widespread utilization. Documenting traditional uses of these plants can inform current applications, guide adaptations, and support future needs. According to the World Health Organization, a medicinal plant is any plant, or part of it, that contains substances capable of being used for therapeutic purposes or that serve as precursors in the synthesis of beneficial pharmaceuticals. [1]. The World Health Organization has redefined traditional medicine (TM) as including healing practices that have been used for generations and continue to be practiced in the present day [2]. It is estimated that 60% to 85% of people in developing nations rely on traditional or indigenous medicine for their primary healthcare needs. The use of traditional remedies for treating various health conditions has been a long-standing practice, established over thousands of years in both developed and developing countries. The importance of these traditional systems of medicine is now widely acknowledged and accepted [3].

Dioscorea villosa, belonging to the *Dioscorea*ceae family, is part of a genus that consists of more than 600 species found across continents including Africa, Asia, the Caribbean, South America, and the South Pacific [4]. Commonly referred to as Wild Yam Root, Colic Root, and Rheumatism Root, *Dioscorea villosa* is recognized in the British Herbal Pharmacopoeia. It is a climbing, tuberous vine with pale brown, knotty, woody, and cylindrical roots. The plant features a slender reddish stem that can extend beyond 9.2 meters in length. Its flowers grow in clusters and are typically greenish-white or greenish-yellow, while the leaves are heart-shaped and symmetrical [5].

Traditionally, *Dioscorea villosa* has been used to relieve conditions such as rheumatoid arthritis, stomach and menstrual cramps, and gallstone-related pain [6]. The plant is rich in a variety of phytochemicals, including steroids, flavonoids, terpenoids, amino acids, glycosides, antioxidants, and polysaccharides. Phytochemical investigations of the plant's rhizomes have led to the identification of two novel bidesmosidic cholestane steroid glycosides, named *Dioscorea*villosides A and B (compounds 1 and 2). Additionally, researchers identified 12 previously known furostan and spirostan steroid glycosides, along with the compound diosgenin [7-8]. The plant also demonstrates several biological activities, such as diuretic, antispasmodic, anti-inflammatory, antirheumatic, cholagogue, diaphoretic, and expectorant effects [5].

The aim of this study is to provide a comprehensive summary of *Dioscorea villosa* covering its botanical characteristics, traditional uses, phytochemical composition and pharmacological properties while also identifying research gaps that could inform future scientific exploration.

Methodology

This review was conducted by collecting relevant scientific literature on *Dioscorea villosa* (commonly known as Wild Yam) from various reliable databases, including Google, Google scholar and Science Direct databases. The information for literature review is collected between (2007-2024). Keywords-*Dioscorea villosa*, Wild Yam, Pharmacological activity, traditional uses, phytochemical constituents were used to retrieve articles.

Taxonomical classification

- **Kingdom:** Plantae
- **Phylum:** Magnoliophyta
- **Class:** Liliopsida
- **Subclass:** Magnoliidae
- **Order:** *Dioscorea*les.
- **Family:** *Dioscorea*ceae.
- **Genus:** *Dioscorea*.
- **Species:** *Dioscorea villosa* [9].

Synonyms

Atlantic yam, china root, colic root, *Dioscorea barbasco*, *Dioscorea hypoglauca*, *Dioscorea opposite* [10].

Vernacular Names

- **English:** Wild yam.
- **Bangla:** KantaAlu.
- **Pakistan:** Khaali.
- **Hindi:** JangaliRatalu.
- **Nepali:** Bhyakur.
- **Tamil:** KattuKizhangu [11].

Description

Dioscorea villosa features cylindrical tubers connected to a twining vine, which is pale brown, knotty, and woody in texture. The tubers are twisted and extend horizontally with branches. The plant has a slender, reddish stem that can grow over 9.2 meters in length. The plant bears clusters of flowers that are either greenish-white or greenish-yellow in color. Its leaves are heart-shaped and symmetrical, featuring a smooth upper surface that narrows into a sharp tip. The upper leaves are arranged alternately in an uneven pattern, whereas the lower leaves are grouped in whorls of four to five. The rhizomes are thin and consist of five twisted sections, each measuring between half an inch to one inch in diameter and often extending up to two feet long. These rhizomes are oval, flattened, and grow horizontally beneath the soil surface. The plant is evergreen, a low-growing creeper that thrives in various soil conditions, from average to poor quality [12].

Fig 1: *Dioscorea villosa*

Geographic Range

Global Distribution

It is distributed across Africa, Asia, the Caribbean region, South America, and the South Pacific islands [4].

Habitat: Climber found wild [13].

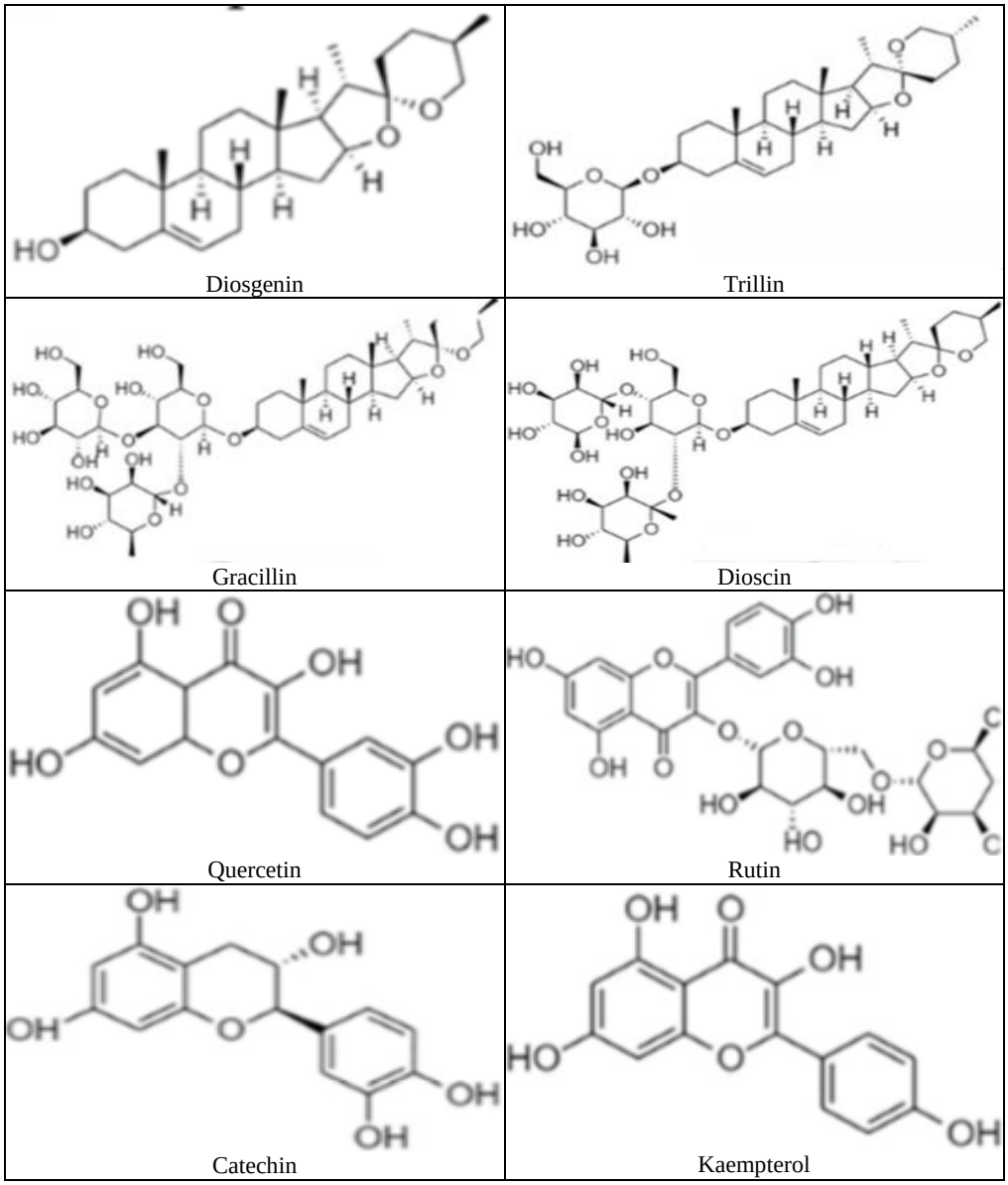
Traditional Uses

Dioscorea villosa plants have been utilized in traditional medicine for centuries to address various health conditions and are considered an essential source of pharmaceutical compounds. Several species within the *Dioscorea* genus are well-known for their extensive history of traditional medicinal applications [7]. Traditionally, *Dioscorea villosa* has been used for conditions such as rheumatoid arthritis, stomach and menstrual cramps, and pain caused by gallstones. Its possible medicinal applications also extend to managing rheumatoid arthritis, menopausal symptoms, diabetes, and muscle cramps. [6]. Roots and rhizomes include the alleviation of menopausal symptoms like hot flashes, mood swings, and vaginal dryness [4]. Traditionally, *Dioscorea villosa* has been used for conditions such as rheumatoid arthritis, stomach and menstrual cramps, and pain caused by gallstones. Its possible medicinal applications also extend to managing rheumatoid arthritis, menopausal symptoms, diabetes, and muscle cramps. [4]. Extracts derived from the leaves have demonstrated the ability to promote wound healing *in vitro* and may stimulate collagen production, which is a crucial protein for skin integrity [14]. *Dioscorea villosa* has also been employed to treat various other conditions, such as ringworm, dysentery, and different skin disorders [7].

Phytochemical Constituents

Studies on the phytochemical composition of *Dioscorea villosa* have revealed important insights into the bioactive compounds found in its tubers, highlighting their potential therapeutic uses [4]. Initial phytochemical screening identified various compounds, including alkaloids, saponins, tannins, flavonoids, steroids, anthraquinones, and cardiac glycosides. Among these, the presence of alkaloids, saponins, flavonoids, and cardiac glycosides was confirmed. The observed contraceptive effects in female rats treated with ethanolic extracts of *Dioscorea villosa* tubers may be attributed to one

or more of these phytochemicals, which may act individually or in combination [15-19]. Saponins, a key component, contain diosgenin, a sapogenin known to help regulate menstrual cycles, ease cramps, and relieve pain during pregnancy and labor [20]. Among the *Dioscorea* genus, *Dioscorea villosa* commonly referred to as wild yam is the most prominent species. From this plant, researchers have isolated two furanostane-type saponins: methyl parvifloside and protodeltonin, as well as two spirostanes: deltonin and glucosidodeltonin. Minor saponins like methylprotodioscin, dioscin, and prosapogenin have also been identified [8]. Furthermore, two flavan-3-ol glycosides were isolated from *Dioscorea villosa*, along with 15 steroidal compounds, including two newly discovered cholestane-type steroidal glycosides *Dioscorea*villosides A and B [8]. In another study, Dong reported the isolation of 14 diarylheptanoids from the rhizomes, five of which were novel and featured a tetrahydropyran ring within the heptane structure [21]. Additional research identified three furostanol saponins parvifloside, methyl protodeltonin, and trigofoenoside from the n-butanol soluble fraction using high-speed counter-current chromatography (HSCCC). Further separation through normal-phase HSCCC yielded four spirostanol saponins: zingiberensis saponin I, deltonin, dioscin, and prosapogenin A of dioscin [22]. Moreover, two distinct series of lipidated steroid saponins have been isolated from *Dioscorea villosa*. Series A consists of five lipidated saponins, including: 5-en-spirostanol-2′-O-rhamnose-3-O-glucoside-6′-O-hexadecanoate, 5-en-spirostanol-2′-O-rhamnose-3-O-glucoside-6′-O-octadecanoate, 5-en-spirostanol-2′-O-rhamnose-3-O-glucoside-6′-O-9Z-octadecenoate, 5-en-spirostanol-2′-O-rhamnose-3-O-glucoside-6′-O-9Z, 12Z-octadecadienoate, 5-en-spirostanol-2′-O-rhamnose-3-O-glucoside-6′-O-9Z, 12Z, 15Z-octadecatrienoate. Series B includes another five compounds, characterized as: 5-en-clionasterol-3-O-glucoside-6′-O-hexadecanoate, 5-en-clionasterol-3-O-glucoside-6′-O-octadecanoate, 5-en-clionasterol-3-O-glucoside-6′-O-9Z-octadecenoate, 5-en-clionasterol-3-O-glucoside-6′-O-9Z, 12Z-octadecadienoate, 5-en-clionasterol-3-O-glucoside-6′-O-9Z, 12Z, 15Z-octadecatrienoate [23].



Pharmacological Activities

Antioxidant Activity

A study examining the antioxidant activity of *Dioscorea villosa* demonstrated that it possesses significant antioxidant properties. Antioxidants are crucial in protecting cells from damage caused by reactive oxygen species. Plants rich in phenolic compounds are known to exhibit potent antioxidant effects. The current study aimed to evaluate the antioxidant

capacity and free radical scavenging activity of the ethanolic extract of *Dioscorea villosa* [24].

Anti-inflammatory activity

Dioscorea exhibits remarkable medicinal and therapeutic properties and serves as a promising source of bioactive substances for the prevention and management of numerous diseases. In recent years, increased research has focused on the phytochemicals present in *Dioscorea*, including steroidal saponins, polyphenols, allantoin, and notably, polysaccharides and diosgenin. These bioactive compounds demonstrate anti-inflammatory effects and offer protection against a range of inflammatory conditions such as enteritis, arthritis, dermatitis, acute pancreatitis, and neuroinflammation. Overall, *Dioscorea* holds great potential as a source for developing novel natural bioactive agents to combat inflammatory and metabolic disorders [25].

Anti-diabetic Activity

Diosgenin, a steroidal saponin obtained from the root of wild yam (*Dioscorea*), is present in various plants. Traditionally, extracts from these plants have been used to treat diabetes [26]. The aim of the present study was to evaluate the antibacterial activity of the ethanolic extract of *Dioscorea villosa* (wild yam) tubers. *Dioscorea villosa* (*Dioscorea*ceae) isused for centuries as a medicinal herb for a wide range of ailments. It is a tuberous, twining vine with pale-brown, knotty wood and cylindrical tubers. Wild yam is sometimes suggested as an alternative to hormone replacement therapy. The ethanolic extract of *Dioscorea villosa* tubers was screened for its antibacterial activity against *Shigella dysenteriae*, *E. coli*, *Vibrio cholera*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus*, using disc diffusion technique. The results of this study showed good bacterial activity against the bacterial species tested, at different concentrations of the extract the aim of the present study was to evaluate the anti-bacterial activity of the ethanolic extract of *Dioscorea villosa* (wild yam) tubers. *Dioscorea villosa* (*Dioscorea*ceae) is used for centuries as a medicinal herb for a wide range of ailments. It is a tuberous, twining vine with pale-brown, knotty, wood and cylindrical tubers. Wild yam is sometimes suggested as an alternative to hormone replacement therapy. The ethanolic extract of *Dioscorea villosa* tubers was screened for its antibacterial activity against *Shigella dysenteriae*, *E. coli*, *Vibrio cholera*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, using discdiffusion technique. The results of this study showed good anti-bacterial activity against the bacterial species tested, at different concentrations of the extract the aim of the present study was to evaluate the anti-bacterial activity of the ethanolic extract of *Dioscorea villosa* (wild yam) tubers. *Dioscorea villosa* (dioscoraceae) is used for centuries as a medicinal herb for a wide range of ailments. It is a tuberous, twining vine with pale-brown, knotty, wood and cylindrical tubers. Wild yam is sometimes suggested as an alternative to hormone replacement therapy. The ethanolic extract of *Dioscorea* villosa tubers was screened for its antibacterial activity against *Shigella dysenteriae*, *E. coli*, *Vibrio cholera*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, using discdiffusion technique. The results of this study showed good anti-bacterial activity against the bacterial species tested, at different concentrations of the extract The aim of the present study was to evaluate the anti-bacterial activity ofthe ethanolic extract of *Dioscorea villosa* (wild yam) tubers. *Dioscorea villosa* (dioscoraceae) is used for centuries as a medicinal herb for a wide range of ailments. It is a tuberous, twining vine with pale-brown, knotty, wood and cylindrical tubers. Wild yam is sometimes suggested as an alternative to hormone replacement therapy. The ethanolic extract of *Dioscorea villosa* tubers was screened for its antibacterial activity against Shigelladysenteriae, *E. coli*, *Vibrio cholera*, *Klebsiella pneumonia*, *Psuedomonas aerugenosa*, *and Staphylococcus aureus* using disc diffusion technique. The results of this study showed good anti-bacterial activity against the bacterial species tested, at different concentrations of the extract the aim of the present study was to evaluate the anti-bacterial activity ofthe ethanolic extract of *Dioscorea villosa* (wild yam) tubers. *Dioscorea villosa* (dioscoraceae) is used for centuries as a medicinal herb for a wide range of ailments. It is a tuberous, twinin gvine with pale-brown, knotty, wood and cylindrical tubers. Wild yam is sometimes suggested as an alternative to hormone replacement therapy. The ethanolic extract of *Dioscorea* velocities was screened for its antibacterial activity against Shigelladysenteriae, *E.coli*, *Vibrio cholera*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, using disc diffusion technique. The results of this study showed good anti-bacterial activity against the bacterial species tested, at different concentrations of the extract.

Antispasmodic Activity

It is utilized as an antispasmodic medication and is therefore applied in the treatment of abdominal cramps, coughs, hiccups, muscular spasms, croup and flatulence. Additionally, it helps in loosening phlegm, inducing vomiting, and increasing urine production [27].

Anticancer Activity

Breast cancer remains the most commonly diagnosed cancer among women globally. Prior studies have shown that Wild Yam Root Extract (WYRE) may influence epigenetic regulation in human breast cancer cell lines. In particular, WYRE has been observed to activate the GATA3 transcription factor in both estrogen receptor-positive (ER^+) MCF-7 cells and estrogen receptor-negative (ER^-) MDA-MB-231 cells. Evidence suggests that WYRE promotes TET enzyme-mediated DNA demethylation, resulting in alterations in GATA3 gene expression. This study aims to determine whether specific constituents within WYRE can directly stimulate the GATA3-dependent signaling pathway. Multiple triterpenoid saponins and a sapogenin have been isolated from the extract, and their anticancer properties have been evaluated *in vitro*. Among them, DS, a plant-derived steroidal glucoside saponin, demonstrated notable anti-proliferative activity across several human cancer cell lines [28].

Acute Toxicity

The toxicological properties of the dry extract were assessed through acute (single dose of 5 g/kg) and sub-chronic (1 g/kg/day for 30 days) toxicity studies. Parameters such as hematological, biochemical, and histopathological markers were examined. Data were expressed as mean ± standard deviation (S.D.), with statistical evaluation performed using Student's t-test or one-way ANOVA, followed by Tukey's post-hoc analysis for pairwise group comparisons. Results from both acute and sub-chronic toxicity tests showed only minor, unremarkable changes, suggesting that oral administration of DV is unlikely to be toxic. Additionally, DV

demonstrated significant antinociceptive and anti-inflammatory effects in rodent models. Importantly, no signs of toxicity were observed in either acute or sub-chronic settings, supporting the traditional use of the plant for treating various inflammatory diseases [29].

Conclusion

Dioscorea villosa is a medicinal plant recognized for its ethnopharmacological relevance. It comprises a variety of bioactive constituents, such as alkaloids, flavonoids, glycosides, steroids, lipids, and more. The plant has shown potential antioxidant, antidiabetic, and anticancer effects. Despite these promising properties, available pharmacological data on this therapeutic species remain limited. Therefore, additional research is essential to isolate its active compounds and elucidate their mechanisms of action. This review aims to present a detailed overview of the botanical characteristics, phytochemical composition, and pharmacological activities of *Dioscorea villosa*, while identifying current knowledge gaps to guide future studies.

Conflict of interest statement

We confirm that there are no competing interests to disclose.

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