

**NUTRITIONAL VALUE, PHYTOCHEMISTRY AND PHARMACOLOGICAL
ACTIVITIES OF *VIGNA UNGUICULATA* (L.) WALP.: A REVIEW**

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ABSTRACT

In the present review the aim was to gather the information related to nutritional value, phytochemistry and biological activities of *Vigna unguiculata* (L) Walp. A literature search of this specie was conducted to obtain information about the nutritional value, phytochemistry and biological activities from various electronic databases (PubMed, PubMed Central, Science Direct, Google schola). The scientific name of this plant species was used as a keyword for the search, along with the terms: traditional uses, botany description, nutritional value, phytochemistry and biological activities. The bibliographic references of this study was made using bibliographic software Mendeley. Results revealed that this plant is traditionally used as stimulant or pain reliever. *Vigna unguiculata*, one of the most used edible plant is reported to possess various biological properties like anthelmintic, antimicrobial, antiviral, hypolipidemic, antioxydant, antidiabetic, hypocholesterolemic, Antisickling, thrombolytic activities. These properties are due to the presence of numerous naturally occurring phytochemicals like flavonoids, alkaloids, tannins, sterols, reducing sugar, terpenoids and phenolic acids. In the conclusion, the present review can, therefore, help to inform future scientific research towards the development of novel drugs of relevance from *Vigna Unguiculata* to improve human health and wellbeing. Especially drug candidates for cancer treatment or external use like wound healing medicines.

KEYWORDS: *Vigna Unguiculata* (L) Walp, medicinal plants, photochemistry and pharmacological activities.

1. INTRODUCTION

Man and Animals depend on the plants for their very existence. Our environment is characterized by richly diversified plant life. Plant diversity is composed of more than 500,000 botanical species (Gangarao, 2011). Tropical medicinal plant species are known for their richness in biologically active secondary metabolites and essential oils of therapeutic relevance. The principal advantages claimed for therapeutic uses of botanicals against various ailments are their safety besides being economical, effective and their easy availability. Because of these advantages the medicinal plants are widely used by the traditional healers in their day to day practice (Ngbolua et al., 2017). The World Health Organization (WHO) reported that about 80% of the population living in developing countries relies on traditional medicine for their primary health care needs (Ngbolua et al., 2017, Inkoto et al., 2018). The Democratic Republic of the Congo (DRC) is a reservoir of both faunal and floristic biodiversity (Ngbolua et al., 2018a, b; Inkoto et al.,

2018; Ngbolua et al., 2016; Masunda et al., 2019). Its flora is full of medicinal plants of biopharmaceutical interest and capable of providing new lead molecules. *Vigna unguiculata* (L) Walp. is a legume of African origin with high protein content. It is cultivated in tropical and subtropical regions and widely distributed throughout the world (Sayeed, 2017). It possesses many biological activities including: anthelmintic, antimicrobial, antiviral, hypolipidemic, antioxydant, antidiabetic, hypocholesterolemic, Antisickling, thrombolytic activities.

The aim of present review is to highlight the nutritional value, phytochemistry and pharmacognosy of this useful medicinal plant species. So that further research could be carried out on this plant.

2. METHODOLOGY

This review is in a narrative format and consists of publications pertinent to *Vigna unguiculata* (L) Walp

available in public domain. A literature search of this specie was conducted to obtain information about the nutritional value, phytochemistry and biological activities from various electronic databases (PubMed, PubMed Central, Science Direct, Google scholar). The scientific name of this plant species was used as a keyword for the search, along with the terms: traditional uses botany description, nutritional value, phytochemistry and biological activities. The bibliographic references of this study were using bibliographic software Mendeley.

3. RESULTS OF RESEARCH

3.1. Botany

Vigna unguiculata called Cowpea or black-eyed pea is a warm-season, annual legume that exhibits a wide range of growth habits. Varieties may be short and bushy, prostrate, or tall and vine-like. Canopy heights can be 2–3 feet, depending on the variety. The upright stems are hollow and hairless, roughly 0.4 or 2/5 inch (1 cm) wide. The stems of twining varieties are thinner. The 4 inch (10 cm) long and 3 inch (8 cm) wide leaves are three-parted, egg-shaped, and hairless. The two lateral leaves are asymmetrical, and the terminal leaf is symmetrical. The plant also has extra floral nectaries, small pores on its leaves and stems of leaves that release nectar and attract beneficial insects. The branchless inflorescence produces stemmed flowers, 1 inch (2.5 cm) long, along the main axis. The flowers can be purple or white. The lowermost whorl of leaves under the flower is bell-shaped. The lobes of the flower are fused, and the lateral petals are shorter than the upper petal. The seeds are born in 3 to 6-inch (8–15 cm) long, slender, round, two-valved pods growing from the leaf axils. There are roughly 6–13 seeds per pod growing within spongy tissue. The kidney-shaped seeds are white with a black mark around the scar that marks the point of attachment to the seed stalk (Ball *et al.*, 2007).

3.2. Ecological And Geographic Distribution

Ferry *et al.* (1997) reported that *V. unguiculata* is cultivated in tropical and subtropical regions and widely distributed throughout the world, occupying a global area of about 12.5 million hectares, with 8 million (64% of the world's area) in western and central Africa and the rest in South and Central America and Asia.

3.3. Traditional Use of *V. Unguiculata*

In Sudan, the plant is traditionally used for treating of many diseases such as stomatitis, corneal ulcers, colic diseases, epilepsy, chest pain and sexually transmitted diseases. Roasted seeds are used to treat neuritis, insomnia, weakness of memory, indigestion, dyspepsia, sensation of pins and needles in limbs, periodic palpitation, congestive cardiac failure etc. it is an excellent medicine for stomatitis, corneal ulcers, coleic diseases, kwasiorkar, marasmus. The plant has ethnomedicinal importance to treat stomatitis, corneal ulcers, colic diseases, epilepsy, chest pain, sexually

transmitted diseases, hyperacidity, nausea and vomiting (Gangarao, 2011).

3.4. Phytochemistry

Many phyto-constituents were identified from different parts of *Vigna unguiculata*. The whole leaves and seeds have been reported to contain secondary metabolites like flavonoids, alkaloids, tannins, sterols, reducing sugar, terpenoids and phenolic acids, such as p-hydroxybenzoic acid, protocatechuic acid, 2,4-dimethoxybenzoic acid, and cinnamic acid derivatives, such as p-coumaric acid, caffeic acid, cinnamic acid and ferulic acid (Nafessa *et al.*, 2017; Reddy, 1985; Cai *et al.*, 2003; Sosulski & Dabrowski, 1984).

3.5. Nutritional Value

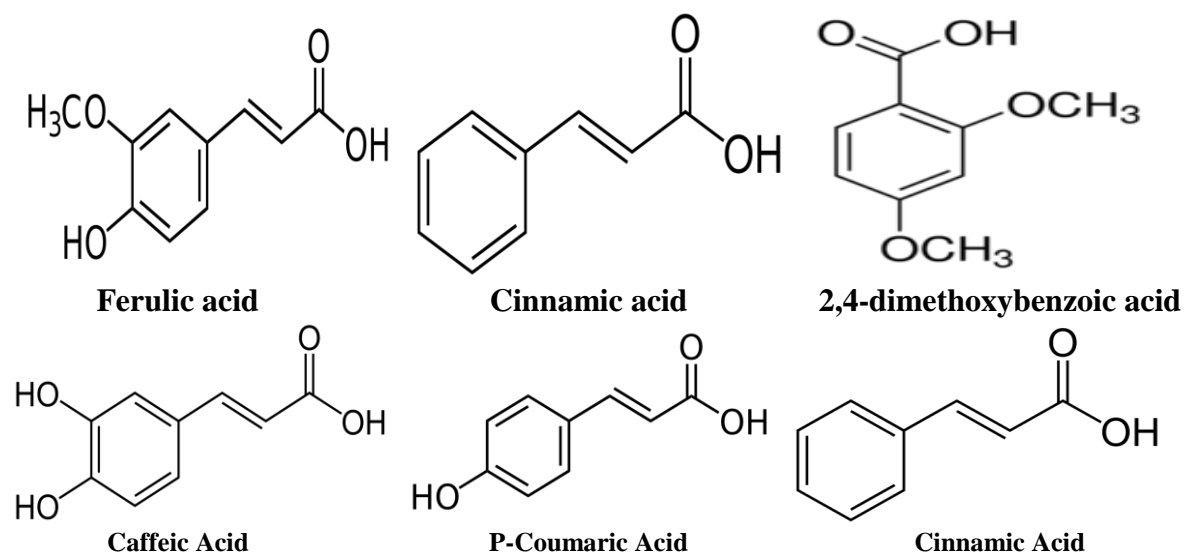
Perunal *et al.* (2007) reported that *Vigna unguiculata* (L.) Walp. as a potential source of protein and other nutrients. The plant was also found to be rich in amino acids like aspartate, threonine, serine, glutamine, proline, glycine, alanine, cysteine, valine, methionine, isoleucine, leucine, tyrosine, phenylalanine, histidine, lysine, arginine and tryptophan. The proximate analysis of the extract indicated appreciable content of protein, moisture, ash, fats and oil and fiber (Egba, 2011).

The amino acid content of the seed extract showed varying concentrations of the amino acids as shown in Table 1.

Table 1: Amino acid content of the seed extract of *Vigna unguiculata* (Egba, 2011).

N°	Amino acids	% Composition	N°	Amino acids	% Composition
1	Aspartate	27.8	10	Methionine	0.8
2	Threonine	27.8	11	Isoleucine	3.2
3	Serine	3.3	12	Leucine	5.4
4	Glutamine	2.6	13	Tyrosine	0.5
5	Proline	43.5	14	Phenylalanine	5.5
6	Glycine	17.6	15	Histidine	4.5
7	Alanine	9.5	16	Lysine	0.5
8	Cysteine	18.7	17	Arginine	14.3
9	Valine	3.6	18	Tryptophan	0.5

Structures of some phenolic acids isolated from *Vigna unguiculata* are given figure 1



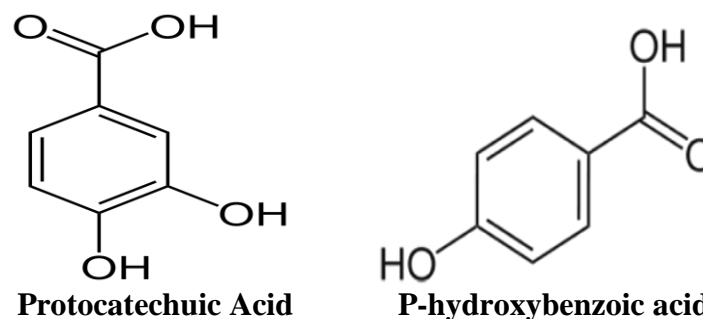


Figure 1: Chemical structures of some compounds isolated from *Vigna unguiculata*.

3.6. BIOLOGICAL ACTIVITIES

Table 2: Extract, pharmacological activity and used plant part of five biologically active compounds isolated from *Vigna unguiculata* (L.) Walp.).

Part of plant	Extracts	Biologically active compounds	Biological activities	Concentration used	Biological model used	References
seeds	Ethanol extract Aqueous extracts	-	anthelmintic activity	(10-100mg/ml)	<i>Edrilus euginiae</i> earthworms	Maisale <i>et al.</i> , 2012
seeds	Ethanol extract Aqueous extracts	-	Antibacterial activity	(100 µg/ml, 200 µg/ml and 300 µg/ml)	<i>Bacillus subtilis</i> and <i>Escherichia coli</i>	Doppalapudi, 2014
	Essential oils		antimicrobial activity	400 µg/disc	<i>B. megaterium</i> , <i>B. subtilis</i> , <i>Sarcinalutea</i> , <i>Salmonella typhi</i> and <i>Staphylococcus aureus</i> , <i>E. coli</i> , <i>Shigelladysenteriae</i> , <i>Shigellasonnei</i> , <i>Shigellashiga</i> , <i>Penicilium spp.</i> , <i>Mucor spp.</i> , <i>Candida albicans</i> and <i>Aspergillusfumigatius</i> .	Mohammad, 2016
	methanolic extract	acetic acid-	Antinociceptive activity		diabetic patients	Tazin, 2014
Seed	Methanolic extract		thrombolytic activity	2mg/ml, 4mg/ml, 6mg/ml, 8mg/ml, 10mg/ml		Saddame 2016
Seed	Methanolic extract	Phenolic acid	Antioxidant activity			
seed	Oil	alloxan monohydrate	Antidiabetic activity	200mg/kg	Rats	Ashraduzzaman, 2011
Seed	Ethanol extract		Antisickling activity	-	sickle cell disease	Egba, 2012
Seed		α -glucosidase, β -glucuronidase	Antiviral and antifungal activity	-	HIV infection,	Ye 2000
seeds			Hypocholesterolemic activity	-	Wistar rats	Pabodha, 2014
Seeds	Ethanol extract		hypolipidemic activity	250 mg / kg; 500 mg / kg	Wistar rats	Nafessa <i>et al.</i> , 2017

3.6.1. Anthelmintic Activity

V. unguiculata (L) Walp. seeds are coarse powdered and exhaustively with hot solvent (Soxhlet) extraction by ethanol and maceration with chloroform water I.P. Five concentration (10-100 mg/mL) of ethanolic and aqueous extracts were studied for anthelmintic activity by using *Edrilus euginiae earthworms*. Both aqueous and ethanolic extracts showed paralysis and death of worms in concentration (10-100mg/mL) dependent manner. Alcoholic extract of *Vigna Unguiculata* (L) Walp showed significant activity than aqueous extract. Piperazine citrate (10mg/mL) and distilled water were included in the assay as standard drug and control respectively. The result showed that seeds of *V. Unguiculata* (L) Walp possessed potential anthelmintic activity (Maisale, 2012)

3.6.2. Antibacterial Activity

Aqueous and ethanolic extracts of seeds of this plant were studied for antibacterial activity and was tested against Gram positive bacteria, *B. subtilis* and Gram negative bacteria, *E. coli* by agar well diffusion method. Different concentrations (100 µg/mL, 200µg/mL and 300 µg/mL) of the extracts were incorporated into the wells. Both the extracts showed concentration dependent activity against the microorganisms investigated. The results showed the highest positive antibacterial activity with an inhibition diameter of 22 mm in case of aqueous extract of 300 µg/mL concentration, against the Gram negative bacteria. The *E.coli* species were found to be more sensitive than that of the *B. subtilis*. The aqueous extract exhibited more antibacterial activity against both the Gram positive and Gram negative organisms than that of the ethanolic extract (Doppalapudi, 2014).

3.6.3. Hypolipidemic Activity

Nafessa *et al.* (2017) reported that *V. unguiculata* seeds and leaves extracts possess significance hypolipidemic effect compared to Atorvastatin standard drug. Addition to seed extract was found to have highly hypolipidemic effect than leaves extract.

3.6.4. Antimicrobial Activity

The antimicrobial activity of *V. unguiculata* (L)Walp seed oil was investigated against five Gram positive bacteria (*B. megaterium*, *B. subtilis*, *Sarcinalutea*, *S. typhi* and *S. aureus*), four Gram negative (*E. coli*, *S. dysenteriae*, *S. sonnei*, *S. shiga*) and four fungi (*Penicilium* spp., *Mucor* spp., *C. albicans* and *A. fumigatius*). Another study reported oil at the concentration of 400 µg/disc showed the highest activity against *Sarcinalutea* (19.0±0.1 mm) and *S. aureus* (16.0±0.1 mm). Oil is active against the three tested fungi namely *Penicilium* spp., *Mucor* spp. and *Candida albicans* but showed no sensitivity against *Aspergillus fumigatius* (Mohammad *et al.*, 2016).

3.6.5. Antinociceptive Activity

Antinociceptive activity was examined through the observation of decrease in abdominal constrictions in intraperitoneally administered acetic acid-induced pain

model in mice. Administration of methanol extract of beans results in dose dependent and significant decreases in blood glucose levels in glucose-loaded mice. The tests for antinociceptive activity results, that the methanolic extract decreases the number of abdominal constrictions by 30.0, 33.3, 36.7, and 43.3%, respectively in all above four doses. This study concluded that the beans can be a good source for alleviating pain and for lowering blood sugar in diabetic patients (Tazin *et al.* 2014).

3.6.6. Antidiabetic Activity

The seed oil of this plant was investigated for its anti-diabetic activity against alloxan monohydrate induced diabetes in rats. Levels of blood glucose, TC, TGs, LDL, ALT, AST and ALP decreased and HDL increased in alloxan induced diabetic rats after treatment with 200 mg/kg barbati seed oil for 21 days. The study reported that the seed oil of cow pea may be very useful for the improvement of the complications of diabetes (Ashraduzzaman, 2011).

3.6.7. Antisickling Activity

Egba [2011] reported the seed extract contains phenylalanine and other amino acids which could explain in part many of the positive effects of the extract in management of sickle cell disease. The preponderance of anti-sickling amino acids in the seed extract of this plant probably must have been responsible for its use in the management of sickle cell disease (Egba, 2011). Natural plant products have been used in Nigerian folk medicine in the management of sickle cell anemia by inhibiting sickling. This work was therefore aimed at investigating the Antisickling potential of the ethanol seed extract of *V. unguiculata* used in the Nigerian herbal medicine with a view of proposing an effective herbal recipe for the management of sickle cell disease. Sickling inhibition test, sickling reversal test and polymerization test were carried out using standard methods. The results of the antisickling test showed that *V. unguiculata* had significantly ($p<0.05$) higher antisickling effect than HbSS control. The result of the polymerization showed that, extracts significantly ($p<0.05$) increased delayed time before polymerization at 50, 25 and 12% concentrations compared to the control. Extracts *V. unguiculata* have shown to be therapeutically beneficial in the management of sickle cell disease and thus it is strongly recommended to be developed into supplements for the management of sickle cell disease (Egba, 2012).

In Congolese traditional medicine *V. unguiculata* is sold in markets for its use in management of sickle cell disease. Its leaves and seeds showed *in vitro* antisickling activity and were proposed as nutraceutical in the management of sickle cell disease (Mpiana *et al.*,2007; Mpiana *et al.*, 2016).

3.6.8. Antiviral and Antifungal Activity

The *V. unguiculata* (L) Walp seeds were examined for the presence of various proteins and amino acids with antiviral and antifungal potency. The two proteins,

designated α - and β -antifungal proteins according to their elution order from the CM-Sepharose column, were capable of inhibiting human immunodeficiency virus (HIV) reverse transcriptase and one of the glycohydrolases associated with HIV infection, α -glucosidase, but β -glucuronidase was not repressed. The ability of the proteins was also demonstrated in order to retarding mycelial growth of a variety of fungi, and α -antifungal protein being proved more potent in most cases. β -Antifungal protein was highly active in only one instance. Both antifungal proteins had low cell-free translation-inhibitory activity (Ye *et al.*, 2000).

3.6.9. Thrombolytic Activity

Inquisition with methanolic extract of *V. unguiculata* (L) Walp (seeds) has anti-thrombolytic activity. *In vitro* Thrombolytic model was used. It is clear that *V. unguiculata* (L) Walp (seed) methanolic extract showed thrombolytic activity significantly while comparing with standard (Saddam *et al.*, 2016).

3.6.10. Hypocholesterolemic Activity

Pabodha *et al.* (2014) reported the seeds of *V. Unguiculata* (L) Walp were investigated for its Hypocholesterolemic activity in Wistar rats. Rats were grouped and fed a high fat diet with 20% Bombay (BO), 20% MI 35 (MI), 20% Cowpea extract, 20% Dawala (DA) in comparison with 20% casein (HFD). Serum total cholesterol, non-HDL cholesterol, triacylglyceride and glucose concentrations were analyzed. Serum lipids and glucose concentrations in cowpea fed rats were significantly lower ($P < 0.05$) than HFD. Therefore, raw cowpea produced significant hypolipidemic and hypoglycemic effects in Wistar rats (Pabodha, 2014).

3.6.11. Antioxidant Activity

Khare (2008) reported that the phenolic compounds present in the extracts showed the antioxidant and antiradical properties when investigated using a linoleic acid peroxidation model, FRAP, ORAC and TRAP assays, as well decoction of dry seeds in calculus and amenorrhoea. Presence of vitamin A in the green pods makes them a valuable diet for children. Green leaves may be used in vitamin C deficiency as DPPH, hydroxyl, nitric oxide and superoxide radical scavenging activity. The HPLC analysis of extracts of this plant showed the presence of neochlorogenic acid, chlorogenic acid and caffeic acids. Another study indicated that methanolic extract of the cowpea resembled in the aforementioned activities those from other leguminous seeds and pulses (Muhammad, 2013).

4. CONCLUSION

Medicinal plant species have the ability to synthesize a wide variety of secondary metabolites that are used to perform important biological activities. The present review was undertaken with the aim of providing highlight and updated information on the medically and scientific evidence supporting the multiple uses of *V. unguiculata* in Congolese Traditional Medicine. The

various compounds and pharmacological activities reported in this review confirm the therapeutic value of *V. unguiculata* (L) Walp.

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