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Caesalpinia volkensii: Unexploited Natural Source of Medicine

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ABSTRACT

The plant of the species *Caesalpinia volkensii* has diverse traditional use. This review aims at providing an overview of the plants traditional utility and scientific potential in managing both infectious and lifestyle diseases. It focuses on the plants hypoglycaemic activity, anti-malarial, anti-nociceptive and anti-inflamatory activity. The review also looks at the antimicrobial property of the plant, phytochemical analysis and safety.

Keywords: *Caesalpinia volkensii*, hypoglycaemic, antimicrobial, anti-inflammatory, phytochemicals.

INTRODUCTION

Medicinal plants have played important role in helping human combat both infectious and lifestyle diseases. Evidence of the herbal use dates back to 60,000 years in Neanderthal man burial site, which was discovered in 1960 in northern Iraq. Scientists found great quantities of pollen from plants, some of which compared relatively well with medicinal plants in use today [1]. Knowledge on herbs has been preserved by passing it through oral communication and cultural practices by communities around the world. This has greatly enabled sustained use of medicinal plants as interventions in diseases management [2].

Through various research works, some medicinal plants have proved to be a primary source of treatment, while others as a better alternative especially in this era of microbial resistance and life style diseases. Looking at the history of herbal medicine, several medicinal plants have demonstrated curative properties. For example, various phytochemicals with anticancer properties have been isolated from a number of plants. About 3000 medicinal plants species have demonstrated anticancer properties, some in the market today [3]. Furthermore, phytochemicals such as carotenoids, quercetin, resveratrol and catechins found in medicinal plants, play a role in combating cardiovascular diseases [4].

Additionally, various medicinal plants extracts have been found to have antibacterial properties. For example, Kareru *et al*. (2007), tested several medicinal plants against *Escherichia coli*, *Staphylococcus aureas* and *Bacilus subtilis* [5]. He found a number of them having antimicrobial activity against these organisms, with varying degree of activity. Different studies around the world have also evaluated other medicinal plants on different microorganisms providing impressive results. In addition, many medicinal plants have shown activity against protozoa infections [6]. Quinine, an effective popular drug which has been in use for almost 400 years is obtained from medicinal plant *Chinchona officinalis* and is used to treat malaria [7]. A variety of anti-helmintics have also been obtained from medicinal plants [8].

Some medicinal plants have antiviral activity. Traditional Chinese medicines are among documented medicinal plants with activity against influenza virus [9]. Fu-Shi *et al*. (2015) demonstrated anti-human immunodeficiency virus (HIV) activity of *Salviae miltiorrhiza* (Salviae) and *Cinnamomi Ramulus* (Cinnamomi) [10]. *Jatropha curcas* Linn. leaf extracts have also been studied for anti HIV activity and shown commendable results [11]. These are some among many studies that have been done to demonstrate antiviral activity of medicinal plants. Several plants extracts are known for their ability to boast the immune system [12], therefore, serving as a way to wade off most of the infections associated with low or lack of immunity.

Caesalpinia volkensii

Caesalpinia comprises about 200 species mainly found in Africa and America tropics. In eastern Africa, the plant species C. *volkensii* is native to Ethiopia, Uganda, Tanzania and Kenya [13]. In Kenya, the

plant grows naturally in parts of Rift Valley, Eastern, and Coast regions [14]. Its main use is for medicinal purposes. *Caesalpinia volkensii* (Harms) is a woody climber of length ranging between 1.8m to 4m. The stems have deflexed prickles and contains bipinnate leaves, which are paired 3 to 6. This plant belongs to the order *Fabales*, of the family *Fabaceae* [15]. It has yellow flowers and petals of about 16 mm by 3.5-4.5 mm. The plant has fruits with seeds that are smooth, shiny and hard to crack [16, 17].

Traditional uses

C. volkensii is used for treatment of malaria, gonorrhea and bilharzias in various parts of the world [18]. It is also used in relieving both labor pains and abdominal pains [19]. It is believed that its roots have aphrodisiac properties. Some traditional practitioners prescribe it for eye problems and stomach ulcers. However, different parts of the plant are used for different purposes. For example, flower buds are used for treating eye problems, seed; ulcers, pods; abdominal pains, roots; aphrodisiac, and leaves; malaria [20]. Other uses of the plant include making dyes [21].

Anti-diabetes activity

Diabetes is a metabolic disorder, characterized by the body inability to utilize glucose for energy. This results from both genetic and epigenetic factors. Management of this condition depends on insulin, oral hypoglycemic agents, diet and exercises [22]. The global rise of this condition is alarming; by the year 2000, there were more than 170 million cases globally, and by the year 2030 these cases are projected to rise to about 366 million [23]. In Kenya, about 200, 000 people suffer from this disease [23]. Apart from exercising, observing diet, use of conventional oral hypoglycemic agents and insulin, researchers are looking for cheap, efficacious, and readily available options from herbs. Among the herbal options, is *C. volkensii*.

Study by Murugi *et al*. (2012), confirmed that peritoneal administration of extracts of *C. volkensii* produce a dose dependent hypoglycemic activity comparable to insulin activity [24]. The study postulated that the plants action may be attributed to the repair of islet of lerngerhans, initiated by the mineral elements in the extract, and insulin like activity of phytochemicals [25]. Phytochemicals which includes Methylhydroxy chalcone polymer, sterols, flavonols, flavones, chalcones and flavonoids from various plants have demonstrated ability to lower blood sugar [24]. This is by way of preserving beta cell and increasing glucose metabolism.

Furthermore, trace elements in plant extracts, play a role by enhancing glucose absorption, insulin synthesis, secretion, cellular sensitivity and protection of beta cells [26]. Marked alterations of mineral elements are evident in diabetes. Medicinal plants provide an alternative for correction of the condition, since many are rich in minerals. The trace elements found in aqueous extracts of *C. volkensii* include Manganese, Copper, Magnesium, Zinc, Molybdenum and Chromium [24]. Deficiency of copper and manganese is associated with glucose intolerance. In addition, Manganese activates antioxidant enzymes therefore protecting cell membranes from oxidative stress [27].

Moreover, zinc plays a great role in production and utilization of insulin [24]. This has been associated with its protective activity on Beta cells and its antiviral properties [28]. Zinc deficiency is linked to insulin deficiency. It is also linked to its increased degradation [28]. Zink deficiency also affects glyceraldehyde-3-phosphate dehydrogenase which is involed in glycolyses [25]. In addition, Zinc plays a great role in maintaining insulin structure and function [29]. The cofactor chromium increases insulin action by enhancing receptor binding, insulin sensitivity and glucose tolerance [24]. Molybdenum accelerates both glycolyses and glycogeneolyses. It also enhances glucose transport and phosphorelation of receptors involved in glucose metabolism. Low magnesium level is associated with retinopathy in diabetes [24]. Both sodium and potassium are significant in transport of amino acids and glucose in cells. At low levels, calcium induces insulin optimal response in both adipose tissue and skeletal muscles [30]. On the other hand, vanadium up regulates insulin receptors, hence increasing their sensitivity to glucose [25]. The trace elements present in *C. Volkensii*, are key in its activity in regulating blood sugar. Common mineral elements found in *C. volkensii* are indicated in Table 1.

Table 1: Indicates mineral elements found in *C. volkensii* linked to the plant activity.

Mineral element	Importance
Zink	▪ Enhance insulin production and utility ▪ Protect beta cells ▪ Antiviral activity ▪ Promotes activity of glyceraldehyde-3-phosphate dehydrogenase
Chromium	▪ Promotes insulin activity
Molybdenum	▪ Accelerates glycolyses and glycogeneolyses ▪ Enhances glucose transport and phosphorelation of receptors
Calcium	▪ Induces insulin optimal response in both adipose tissue and skeletal muscles
Vanadium	▪ Increases cell receptors sensitivity to insulin
Manganese	▪ Activates antioxidant enzymes
Cupper	▪ Provides protection from oxidative stress
Magnesium	▪ Protects against retinopathy in diabetes
Sodium	▪ Involved in transport of amino acids and glucose in cells
Potassium	▪ Involved in transport of amino acids and glucose in cells

Plant safety

Histopathology examination of mice tissues following intraperitoneal administration of aqueous leaf extracts of *C. volkensii* did not indicate major pathological effect [24]. Upon oral administration of methanolic leaf extracts of *C. volkensii* at 2000 mg/kg body weight in rat model, Musila *et al*. (2017) concluded that the median lethal dose of the extracts is beyond 2000 mg/kg body weight, hence safe. For sub acute oral toxicity, doses below 1000 mg/kg body weight were found to be safe [19].

Pain and inflammation

The study on dichloromethane (DCM): methanolic extracts of *C. Volkensii* on animal models led to the conclusion that *C. Volkensii* has anti-inflammatory and anti-nociceptive properties [31]. The study confirmed tradition use of the plant in controlling pain. This could be

attributed to the present of useful phytochemical in the extract [32]. Flavanoids for example, can inhibit degranulation of neutrophil, hence diminishing arachidonic acid production [33]. In addition, flavanoids interfere with production of pain mediator postglandlins, by inhibiting the enzyme endoperoxidase [34]. Similarly, some alkaloids have anti-inflammatory and anti-nociceptive properties [35].

Antimalarial Activity

Caesalpinia volkensii has been tested in the control of malaria. This has been done in comparison to chloroquine. The study shown that extracts of the plant gave malaria infected mice an increased survival period, compared to the untreated group. This could have been through immunomodulation, direct parasiticidal activity and pharmacological effects of the plant extracts. However, the plant extracts prepared using petroleum, chloroform, methanol, ether and water, only shown activity at concentrations higher than those of chloroquine [36].

Antimicrobial activity

Dichloromethane, methanolic, ethanolic and hexane leaf extracts of *C. volkensii* resulted in antibacterial activity on both gram positive and gram-negative bacteria [37]. The organism tested included, *Staphylococcus aureus*, *Bacillus subtitis* and *Escherichia coli*. The zones of inhibition raged between 1.6mm to 4mm. Subjection of *Candida albicans* to the DCM and methanolic extract resulted to inhibition zones of 2.7mm and 2mm respectively [37]. However, DCM and ethanolic extracts did not have any activity against *Pseudomonus aeroginosa* [37].

Several Phytochemical have been documented to contain antimicrobial activity. For example, Alkaloids can inhibit protein biosynthesis, by interacting with neuroreceptors [32]. Flavanoids, tannin, lectins, polypeptides and phenolics are also believed to contain antimicrobial activity [38]. Therefore, the antimicrobial activity of the extracts could be attributed to phytochemical.

Phytochemicals

Aqueous extracts of *C. volkensii* leaves contains Sterols, Terpenoids, Taninnis, Anthroquinones, Flavanoids, Alkaloids and Chalcones [24]. Phytochemical analysis of Methanolic leaf extracts of *C. volkensii* yeilded terpenoids, flavanoids, phenols, saponins and alkaloids [19]. Qualitative phytochemical screening of water extracts of *C. volkensii* seeds indicated the presences of anthroquinones and alkaloids [39].

Phytochemicals have been shown to influence metabolism in animal cell. For example, sterols and flavanoids can lower blood glucose in diabetic animals [23]. Flavanoids like flavone C-glycoside and Caesalpin P can protect B-Cells from damage in rats [32]. Furthermore, flavanoids can stimulate peripheral glucose uptake and enhance lipogenesis [40]. Alkaloids and flavanoids obtained from *Clitoria ternatea* Linn methanolic root extract, have hypoglycemic effects in normal and diabetic Rats [41]. Besides, Tannins and Saponins cause hypoglycemia in elderly patients. The mechanism of action is thought to involve inhibition of α-amylase and α-glucosidase enzymes [23]. Terpenoids have also been associated with blood glucose lowering ability [43]. Common isolated Phytochemicals from *C. volkensii* are indicated in Table 2.

Table 2: Indicates Phytochemicals commonly isolated from *C. volkensii* linked to plant activity

Phytochemicals	Importance
Phenols	▪ Anti-inflammatory ▪ Lowers blood sugar
Alkaloids	▪ Inhibit protein biosynthesis in microorganisms ▪ Lowers blood sugar ▪ Anti-inflammatory properties ▪ Anti-nociceptive properties
Flavanoids	▪ Antimicrobial activity ▪ Lowers blood glucose ▪ Protect Beta cell from damage ▪ Stimulate peripheral glucose uptake ▪ Enhance lipogenesis ▪ Interfere with production of pain mediator; postglandlins, by inhibiting the enzyme endoperoxidase ▪ Alleviate abdominal pain
Saponins	▪ Lowers blood sugar by Inhibition of α-amylase and α-glucosidase enzymes ▪ Antimicrobial
Terpenoids	▪ Lowers blood sugar by inhibition of α-amylase and α-glucosidase enzymes ▪ Anti-inflammatory
Sterols	▪ Lowers blood glucose ▪ Antipyretic properties ▪ Anti-inflammatory properties
Tannins	▪ Lowers blood glucose ▪ Antimicrobial activity

CONCLUSION

From the scientific viewpoint, it is evident that *C. volkensii* can be used to manage pain, inflammation, malaria and diabetes. In addition, its safety is guaranteed. However, further research is needed to substantiate the claims of its traditional application in treatment of ulcers, eye problems, sexually transmitted infections and its aphrodisiac properties. Moreover, most tests have been conducted on animal models hence the need for clinical studies. There is also need to isolate, bio-screen and quantify individual phytochemicals, in order to associate them with specific outcomes. Furthermore, looking on how these phytochemicals affect specific metabolic pathways is equally important.

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