A synthesis and review of ethnomedicinal uses, phytochemistry and biological activities of Antidesma venosum E. Mey. ex Tul. (Phyllanthaceae)

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ABSTRACT

Antidesma venosum is an evergreen to semi-deciduous tree used traditionally to treat various human and animal diseases. This review aims to provide an overview and critically analyze the ethnomedical uses, phytochemistry and biological activities of A. venosum. The results of the current study are based on literature survey conducted using various search engines such as Elsevier, Pubmed, Google Scholar, PubMed, Springer, Science Direct, Taylor and Francis, and pre-electronic sources such as books, book chapters, scientific journals and other grey literature. The bark, fruit, leaf, root and stem bark decoction or infusion of A. venosum are mainly used for magical rituals, as anthelmintic and ethnoveterinary medicine, and traditional cure for epilepsy, hernia, malaria, skin infections, oral candidiasis, snakebites, sexually transmitted infections, abdominal pains, menstrual problems, respiratory infections, infertility, and gastrointestinal infections. The chemical constituents identified from A. venosum include essential oils, isoquinoline alkaloids, triterpenoids, lactones, phytosterols, saponins, cardiac glycosides, tannins and flavonoids. The species possesses a wide range of biological activities which include antibacterial, antimycobacterial, antifungal, anti-inflammatory, antioxidant, antischistosomal, mutagenic and cytotoxicity activities. Antidesma venosum is a valuable medicinal plant species, and future research should focus on animal experiments aimed at assessing toxicity and clinical efficacy of species extracts.

INTRODUCTION

Antidesma venosum E. Mey. Ex Tul. is a small tree of the Phyllanthaceae family. The genus name Antidesma L. is derived from the Greek words “anti” meaning “for” and “demos” meaning “band” about the bark of the species used for cordage (Palmer and Pitman, 1972). The species name “venosum” is a Latin word which means “conspicuously veined” about the bold veining of the leaves (Palmer and Pitman, 1972). The synonyms of A. venosum include A. bifrons Tul., A. boivinianum Baill., A. fuscocinereum Beille, A. neriifolium Pax & K. Hoffm. And A. tomentosa Fenzl. Antidesma venosum has been recorded in coastal bushveld, woodland, forest margins and grassland in tropical Africa (Palgrave and Keith, 2002). The fruits of A. venosum are edible in Benin, Ethiopia, Kenya, Mozambique, South Africa and Zimbabwe. The stems of A. venosum are used as chewing sticks in Ghana while the leaves of the species are browsed by game and livestock. The bark of A. venosum is traded as a traditional medicine in informal herbal medicine markets in South Africa and Tanzania. Therefore, this review aims to provide a comprehensive appraisal of the ethnomedicinal uses, phytochemistry and biological activities of...
### Table 1: Medicinal uses of Antidesma venosum

| Medicinal use                  | Part used                                      | Country                          | Reference                                      |
|-------------------------------|-----------------------------------------------|----------------------------------|------------------------------------------------|
| Abdominal pains               | Fruits, leaves, roots and twigs                | DRC, South Africa, Tanzania      | (Chhabra et al., 1993)                         |
| Anthelmintic                  | Roots                                          | DRC and South Africa             | (Palgrave and Keith, 2002)                     |
| Aphrodisiac                   | Roots                                          | DRC                              | (Mbayo et al., 2016)                           |
| Backache                      | Stem                                           | Tanzania                         | (Choi et al., 2015)                            |
| Blennorrhoea                  | Roots                                          | DRC                              | (Mbayo et al., 2016)                           |
| Body pain                     | Roots                                          | South Africa                     | (Palgrave and Keith, 2002)                     |
| Diabetes                      | Roots                                          | DRC                              | (Mbayo et al., 2016)                           |
| Epilepsy                      | Roots                                          | Malawi and Tanzania              | (Moshi et al., 2005)                           |
| Expulsion of retained placenta| Roots                                          | Tanzania                         | (Chhabra et al., 1993)                         |
| Fish poison                   | Leaves                                         | Tanzania                         | (Neuwinger, 2004)                              |
| Gastrointestinal problems     | Leaves, roots and stem bark                    | DRC, Mozambique, Namibia, Nigeria, South Africa and Tanzania | (Mbayo et al., 2016) |
| Stomach complaints            | Leaves mixed with those of Zanthoxylum capense (Thunb.) Harv., Trimeria grandifolia (Hochst.) Warb., Graderia scabra Benth. and Canthium inerme (L. f.) Kuntze | South Africa                     | (Arnold and Gulumian, 1984)                     |
| Hernia                        | Roots and stem bark                            | Mozambique and Tanzania Guinea    | (Chhabra et al., 1993)                         |
| Hypertension                  | Leaves                                         | Guinea                           | (Kabine et al., 2015)                          |
| Infertility                   | Roots mixed with those of Combretum paniculatum Vent. and Grewia microthyrsa K. Schum. ex Burret | South Africa                     | (Chhabra et al., 1993)                         |
| Infertility                   | Roots mixed with those of Artabotrys brachypetalus Benth., Dichrostachys cinerea (L.) Wight & Arn. and Zantedeschia aethiopica (L.) Spreng. | South Africa                     | (Arnold and Gulumian, 1984)                     |
| Liver complaints              | Roots                                          | Kenya                            | (Chhabra et al., 1993)                         |
| Magical rituals and charm     | Leaves and roots                               | Malawi and Tanzania              | (Augustino, 2011)                              |

*Continued on next page*
| Medicinal use                     | Part used                          | Country                                      | Reference                                      |
|----------------------------------|------------------------------------|----------------------------------------------|------------------------------------------------|
| Menstrual problems               | Roots                              | DRC, South Africa and Tanzania               | (Chhabra et al., 1993)                         |
| Malaria                          | Leaves and roots                   | DRC and Tanzania                             | (Chhabra et al., 1993; Mbayo et al., 2016)     |
| Mental illness                   | Stem bark mixed with Hyparrhenia subplumosa Stapf | Nigeria                                      | (Ibrahim et al., 2008)                         |
| Oral candidiasis                 | Roots                              | Namibia and Tanzania                         | (Kisangau et al., 2007)                        |
| Respiratory infections (chest pain, cough and tuberculosis) | Roots                              | Namibia, South Africa and Tanzania           | (Chhabra et al., 1993)                         |
| Schistosomiasis                  | Roots                              | Tanzania                                     | (Chhabra et al., 1993)                         |
| Sexually transmitted infections (gonorrhea, syphilis and venereal diseases) | Roots                              | DRC, Mozambique and Tanzania                 | Chhabra et al. (1993)                          |
| Skin infections (abscess and acne) | Fruits and roots                   | Angola, DRC and South Africa                 | (Mbayo et al., 2016)                           |
| Snakebites                       | Bark, leaves and roots             | DRC and Tanzania                             | (Mbayo et al., 2016)                           |
| Tonic                            | Roots                              | South Africa                                 | (Arnold and Gulumian, 1984)                    |
| Toothache Ulcers                 | Roots                              | DRC                                          | (Mbayo et al., 2016)                           |
| Uterine prolapse                 | Bark                               | Tanzania                                     | (Chhabra et al., 1993)                         |
| Vomiting                         | Roots                              | Tanzania                                     | (Chhabra et al., 1993)                         |
| Ethnoveterinary medicine (anthelmintic and wounds) | Stem and stem bark                  | Kenya and Côte d’Ivoire                     | (Arnold and Gulumian, 1984)                    |
|                                  |                                    |                                              | (Njoroge et al., 2010)                         |
Table 2: Phytochemical compounds isolated from Antidesma venosum

| Phytochemical compound                                      | Value | Plant part             | Reference                      |
|------------------------------------------------------------|-------|------------------------|--------------------------------|
| 1-methyl-2,4-bis(1-methylethenyl)cyclohexane (%)           | 1.7   | Leaves                 | (Egharevba et al., 2015)       |
| 3,7,11,15-tetramethyl-(E,E)-1,6,10,14-Hexadecatetraen-3-ol (%)| 1.6   | Leaves                 | (Egharevba et al., 2015)       |
| (3R,4R,5S)-4-hydroxy-5-methyl-3-tetradecanyl γ-lactone     | -     | Root bark              | (Magadula et al., 2013)        |
| 14-Heptadecenal (%)                                        | 0.1   | Leaves                 | (Egharevba et al., 2015)       |
| Antidesmone                                                | -     | Leaves                 | (Bringmann et al., 2000, 2001) |
| Betulinic acid                                             | -     | Root bark              | (Magadula et al., 2012)        |
| Caryophyllene (%)                                          | 7.1   | Leaves                 | (Egharevba et al., 2015)       |
| Caryophyllene oxide (%)                                    | 4.7   | Leaves                 | (Egharevba et al., 2015)       |
| cis-1,2-Cyclohexanediolmethanol (%)                         | 0.4   | Leaves                 | (Egharevba et al., 2015)       |
| (R)-(+)Citronellal (%)                                      | 29.0  | Leaves                 | (Egharevba et al., 2015)       |
| Citronellol (%)                                             | 0.03  | Leaves                 | (Egharevba et al., 2015)       |
| Citronellyl acetate (%)                                     | 12.0  | Leaves                 | (Egharevba et al., 2015)       |
| Condensed tannin (%)                                       | 0.7   | Leaves                 | (Fawole et al., 2009b)         |
| Docosane (%)                                                | 1.1   | Leaves                 | (Egharevba et al., 2015)       |
| Epifriedelanol                                              | -     | Root bark              | (Magadula et al., 2012)        |
| Eucalyptol (%)                                              | 3.2   | Leaves                 | (Egharevba et al., 2015)       |
| β-Eudesmene (%)                                             | 0.6   | Leaves                 | (Egharevba et al., 2015)       |
| α-Farnesene (%)                                             | 0.6   | Leaves                 | (Egharevba et al., 2015)       |
| (E)-β-Farnesene (%)                                        | 0.2   | Leaves                 | (Egharevba et al., 2015)       |
| Farnesol (%)                                                | 0.6   | Leaves                 | (Egharevba et al., 2015)       |
| Farnesyl acetone (%)                                       | 0.9   | Leaves                 | (Egharevba et al., 2015)       |
| Flavonoid (mg CE/g)                                         | 2.8   | Leaves                 | (Fawole et al., 2009b)         |
| Friedelin                                                  | -     | Root bark and stem bark| (Magadula et al., 2012, 2013)  |

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| Phytochemical compound | Value | Plant part | Reference |
|------------------------|-------|------------|-----------|
| Gallotannin (μg GAE/g) | 0.8   | Leaves     | (Fawole et al., 2009b) |
| cis-Geranylacetone (%) | 1.1   | Leaves     | (Egharevba et al., 2015) |
| Heneicosane (%)        | 0.6   | Leaves     | (Egharevba et al., 2015) |
| Hexahydrofarnesyl acetone (%) | 0.1 | Leaves     | (Egharevba et al., 2015) |
| Humulene (%)           | 0.9   | Leaves     | (Egharevba et al., 2015) |
| trans-β-Ionone (%)     | 0.5   | Leaves     | (Egharevba et al., 2015) |
| Isopulegol (%)         | 2.2   | Leaves     | (Egharevba et al., 2015) |
| Lupeol                 | -     | Stem bark  | (Egharevba et al., 2015) |
| Methyl citronellate (%)| 1.3   | Leaves     | (Egharevba et al., 2015) |
| Neo-Menthol (%)        | 0.4   | Leaves     | (Egharevba et al., 2015) |
| Neryl acetate (%)      | 0.9   | Leaves     | (Egharevba et al., 2015) |
| Pheophytin A           | -     | Root bark  | (Magadula et al., 2012) |
| Phytol (%)             | 4.1   | Leaves     | (Egharevba et al., 2015) |
| Presqualene acetate    | -     | Root bark  | (Magadula et al., 2012) |
| Presqualene alcohol    | -     | Root bark  | (Magadula et al., 2012) |
| β-sitosterol           | -     | Root bark and stem bark | (Magadula et al., 2013) |
| Stigmasterol           | -     | Stem bark  | (Magadula et al., 2013) |
| Tetracosane (%)        | 6.0   | Leaves     | (Egharevba et al., 2015) |
| Tetradecanal (%)       | 7.0   | Leaves     | (Egharevba et al., 2015) |
| n-Tridecan-1-ol (%)    | 0.7   | Leaves     | (Egharevba et al., 2015) |
| (Z)-7-Hexadecenal (%)  | 2.6   | Leaves     | (Egharevba et al., 2015) |
| (Z)-7-Tetradecenal (%) | 0.2   | Leaves     | (Egharevba et al., 2015) |
| α-tocopherol           | -     | Root bark  | (Magadula et al., 2012) |
| Toddaculin             | -     | Root bark  | (Magadula et al., 2012) |
| Total phenolics (mg GAE/g) | 13.0 | Leaves     | (Fawole et al., 2009b) |
| (Z)-2,6,10-trimethyl-1,5,9-Undecatriene (%) | 0.6 | Leaves     | (Egharevba et al., 2015) |
A. venosum.

MATERIALS AND METHODS

An extensive literature survey related to *A. venosum* was conducted using various search engines such as Elsevier, Pubmed, Google Scholar, Springer, Science Direct, Taylor and Francis, and pre-electronic sources such as books, book chapters, scientific journals and other grey literature. The literature search was conducted using keywords such as “Antidesma venosum”, “medicinal uses of Antidesma venosum”, “phytochemicals of Antidesma venosum”, “biological activities of Antidesma venosum”, “ethnobotany of Antidesma venosum”, and various other synonyms of the plant species.

RESULTS AND DISCUSSION

Medicinal uses of *Antidesma venosum*

The bark, fruit, leaf, root, stem bark and twig decoction or infusion of *A. venosum* are mainly used for magical rituals, as anthelmintic and ethnoveterinary medicine, and traditional medicine for epilepsy, hernia, malaria, menstrual problems, skin infections, oral candidiasis, snakebites, sexually transmitted infections, abdominal pains, respiratory infections, infertility and gastrointestinal infections (Table 1, Figure 1). In South Africa, the leaves of *A. venosum* are mixed with those of *Zanthoxylum capense* (Thunb.) Harv., *Trimeria grandiﬁolia* (Hochst.) Warb., *Graderia scabra* Benth. and *Canthium inerme* (L. f.) Kuntze as traditional medicine for stomach complaints. (Arnold and Gulumian, 1984) argued that the roots of *A. venosum* are mixed with those of *Combretum paniculatum* Vent. and *Grewia microthyrsa* K. Schum. ex Burret or are mixed with those of *Artabotrys brachypetalus* Benth., * Dichrostachys cinerea* (L.) Wight & Arn. and *Zantedeschia aethiopica* (L.) Spreng. As remedies for infertility. In Nigeria, the stem bark of *A. venosum* is mixed with the grass, *Hyparrhenia subplumosa* Stapf as traditional medicine for mental illness (Ibrahim et al., 2008).

Phytochemistry of *Antidesma venosum*

A variety of chemical compounds have been isolated and identified from *A. venosum*, including essential oils, an isoquinoline alkaloid, triterpenoids, lactones and phytosterols (Table 2). Other phytochemical compounds identified from the leaves, roots and stem bark of *A. venosum* include carbohydrate, saponins, cardiac glycosides, reducing sugars, steroid, tannins and flavonoids.

Biological activities of *Antidesma venosum*

Pharmacological research revealed that different extracts of *A. venosum* and compounds isolated from the species have various biological activities such as antibacterial, antymycobacterial, antifungal, anti-inflammatory, antioxidant, antischistosomal, mutagenic and cytotoxicity activities.

Antibacterial activities

(Mayekiso et al., 2009) evaluated the antibacterial activities of acetone leaf extracts of *A. venosum* against *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Enterococcus faecalis* and *Enterococcus coli* using the following microdilution method. The extract exhibited activities against the tested pathogens with minimum inhibitory concentration (MIC) values as low as 0.02 mg/ml (Mayekiso et al., 2009). (Fawole et al., 2009a) evaluated the antibacterial activities of dichloromethane, petroleum ether and ethanol extracts of *A. venosum* leaves against *Escherichia coli*, *Bacillus subtilis* and *Staphylococcus aureus* using the microdilution technique with neomycin (100.0 μg/ml) as a positive control. The extracts exhibited activities against tested pathogens with MIC values ranging from 0.7 mg/ml to 9.4 mg/ml (Fawole et al., 2009a). (Mwangomo et al., 2012) evaluated the antibacterial activities of crude, petroleum ether, dichloromethane and methanol extracts of *A. venosum* roots and stem bark against *Streptococcus faecalis*, *Bacillus cereus*, *Bacillus subtilis*, *Bacillus anthracis*, *Klebsiella pneumoniae*, *Salmonella typhi*, *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa* and *Shigella flexneri* using the broth microdilution method with gentamicin as a positive control. The extracts exhibited activities against the tested pathogens with MIC values ranging from 0.02 mg/ml to 5.0 mg/ml (Mwangomo et al., 2012). (Magadula et al., 2013) evaluated the antibacterial activities of the compounds (3R, 4R, 5S)-4-hydroxy-5-methyl-3-tetradecanyl γ-lactone, friedelin, lupeol and β-sitosterol isolated from the root bark and stem bark of *A. venosum* against *Enterococcus faecalis*, *Staphylococcus aureus*, *Bacillus cereus*, *Streptococcus pyogenes*, *Escherichia coli*, *Pseudomonas aeruginosa* and *Shigella flexneri* using broth microdilution method with gentamicin as a positive control. All compounds exhibited activities against tested pathogens with MIC values ranging from 0.2 mg/ml to >2.5 mg/ml (Magadula et al., 2013). (Shengo et al., 2013; Shengo and Mundongo, 2020) evaluated the antibacterial activities of crude extracts of *A. venosum* stem against *Klebsiella pneumoniae*, *Salmonella typhii* and *Proteus mirabilis* using agar dilution method. The extract exhibited activities against *Salmonella typhii* and *Proteus mirabilis* with MIC values ranging from 6.3 mg/ml to 12.5
mg/ml (Shengo et al., 2013; Shengo and Mundongo, 2020). (Tor-Anyin and Yakumbur, 2012) evaluated the antibacterial activities of methanol, ethyl acetate, n-pentanol and water extracts of stem bark of A. venosum against Staphylococcus aureus, Escherichia coli and Salmonella typhi using the agar well diffusion method. The extracts exhibited activities against tested pathogens with the zone of inhibition ranging from 0.3 mm to 6.3 mm (Tor-Anyin and Yakumbur, 2012). (Adegoke et al., 2013) evaluated the antibacterial activities of methanol and ethanol leaf extracts of A. venosum against Staphylococcus aureus, Escherichia coli, Proteus Vulgaris, Salmonella typhi, Streptococcus lactis and Shigella spp. Using the agar well diffusion method with gentamycin (1.0 µg/ml) as a positive control. The extracts exhibited activities against tested pathogens with a zone of inhibition ranging from 6.0 mm to 21.0 mm, MIC and minimum bactericidal concentration (MBC) values ranged from 6.3 mg/ml to 12.5 mg/ml and 6.3 mg/ml to 50.0 mg/ml, respectively (Adegoke et al., 2013). (Shirinda et al., 2019) evaluated the antibacterial activities of aqueous and organic extracts of A. venosum leaves against Bacteroides fragilis, Bacteroides ovatus, Bacteroides thetaiotaomicron, Bacteroides vulgatus, Clostridium difficile, Clostridium perfringens, Fusobacterium nucleatum, Fusobacterium varium, Helicobacter pylori, Escherichia coli and Enterococcus faecalis using the microdilution method. The extracts exhibited the best activities against Clostridium perfringens with MIC value of 60.0 µg/mL (Shirinda et al., 2019).

**Antimycobacterial activities**

(Mayekiso et al., 2009) also evaluated the antimycobacterial activities of acetone leaf extracts of A. venosum against Mycobacterium fortuitum and Mycobacterium smegmatis using the serial microdilution method. The extract exhibited activities against the tested pathogens with MIC values as low as 0.02 mg/ml (Mayekiso et al., 2009). (Mmushi et al., 2010) evaluated the antimycobacterial activities of acetone, dichloromethane, hexane and methanolic extracts of A. venosum leaves against Mycobacterium smegmatis using the broth microdilution with rifampicin as a positive control. The extracts exhibited activities with MIC values ranging from 0.3 mg/ml to 1.3 mg/ml and total activity ranging from 16.0 ml/g to 126.6 ml/g (Mmushi et al., 2010).

**Antifungal activities**

(Fawole et al., 2009a) evaluated the antifungal activities of dichloromethane, petroleum ether, and ethanol extracts of A. venosum leaves against Candida albicans using the microdilution technique with amphotericin B as a positive control. The extracts exhibited activities against tested pathogen with MIC values ranging from 3.1 mg/ml to 6.3 mg/ml (Fawole et al., 2009a). (Mwango et al., 2012) evaluated the antifungal activities of crude, petroleum ether, dichloromethane...
and methanol extracts of *A. venosum* roots and stem bark against *Candida albicans* and *Cryptococcus neoformans* using the broth microdilution method with fluconazole as a positive control. The extracts exhibited activities against tested pathogens with MIC values ranging from 2.5 mg/ml to 5.0 mg/ml (Mwangomo et al., 2012, 2013). The extracts exhibited activities against tested pathogens with MIC values ranging from 2.5 mg/ml to 80.3 mg/ml (Kabine et al., 2015, 2013). The extracts exhibited activities against the tested pathogens with MIC values of >2.5 mg/ml (Magadula et al., 2013). The extracts exhibited activities against the tested pathogens with MIC values of 2.5 mg/ml to 103.0 mg/ml at the highest test concentration (Fawole et al., 2009b).

**Anti-inflammatorv activities**

Fawole et al., 2009b evaluated the anti-inflammatory activities of *A. venosum* by assessing the ability of dichloromethane, ethanol, petroleum ether and water leaf extracts of the species to inhibit cyclooxygenase 1 and 2 (COX 1 and COX 2) enzymes. The dichloromethane, ethanol and petroleum ether extracts showed suitable activities against COX 1 enzymes with inhibition of prostaglandin synthesis of 72.8% to 103.0% at the highest test concentration of 250 μg/mL (Fawole et al., 2009b).

**Antioxidant activities**

Kabine et al. (2015) evaluated the antioxidant activities of methanol, water and ethyl acetate extracts of *A. venosum* leaves using the 1,1-diphenyl-2-picrylhydrazyl (DPPH) free radical scavenging assay with quercetin as a positive control. The extract exhibited activities with percentage inhibition of about 80.0% (Kabine et al., 2015).

**Antischistosomal activities**

Sparg et al., 2000 evaluated the antischistosomal activities of crude extracts of *A. venosum* roots against the schistosomula of *Schistosoma haematobium* with praziquantel as a positive control. The schistosomula were placed into a culture medium to which the plant extract was added. The extract exhibited activities at 12.5 mg/mL, killing 33.3% of the schistosomula worms and killing 100.0% of the worms at a concentration of 1.6 mg/mL in comparison to MIC value was 1.0 μg/mL exhibited by the positive control (Sparg et al., 2000).

**Mutagenic activities**

Elgorashi et al., 2002 evaluated the mutagenic activities of dichloromethane and 90.0% methanol extracts of leaf twigs of *A. venosum* using the Ames test, micronucleus test, comet assay and VITOTOX® test. The dichloromethane extract exhibited mutagenicity or DNA damage and chromosomal aberrations in the micronucleus test and comet assay (Elgorashi et al., 2002; Taylor et al., 2003) evaluated the mutagenic activities of dichloromethane extract of leaves and twigs of *A. venosum* using the Ames test, micronucleus test, comet assay and VITOTOX® test. The extracts exhibited activities in the micronucleus test and comet assay (Taylor et al., 2003).

**Cytotoxicity activities**

Steenkamp et al., 2009 evaluated the cytotoxicity activities of crude root extracts of *A. venosum* against human adenocarcinoma cells of the cervix (HeLa), human breast cells (MCF-12A), lymphocytes (both resting and stimulated) as well as primary porcine hepatocytes using the using 3-(4,5-dimethyl-2-thiazolyl)-2,5-diphenyl-2H-tetrazolium bromide (MTT) assay. The acute systemic toxicity of the crude extract was determined using the BioTox®TM and vertebrate test against *Vibrio fischeri* and *Poecilia reticulata*, respectively. The extract exhibited concentration-dependent activities with half-maximal inhibitory concentration (IC50) values of 25.4 μg/mL and 44.0 μg/mL against HeLa and MCF-12A cells, respectively. The extract caused 100% mortality of the bacterial pathogens indicating that the species is cytotoxic and possesses acute systemic toxicity (Steenkamp et al., 2009). Mwangomo et al., 2012 evaluated the cytotoxicity activities of crude, petroleum ether, dichloromethane and methanol extracts of *A. venosum* roots and stem bark using the brine shrimp lethality test with cyclophosphamide as a positive control. The extracts exhibited activities with half-maximal lethal concentration (LC50) values ranging from 25.5 μg/mL to 80.3 μg/mL (Mwangomo et al., 2012).

**CONCLUSIONS**

This review showed that several phytochemicals characterize *A. venosum* and the species exhibited antibacterial, antymycobacterial, antifungal, anti-inflammatory, antioxidant, antischistosomal, mutagenic and cytotoxicity activities. However, the majority of these biological activities lack bio guided isolation strategies and mechanisms of action. Therefore, future research should focus on pharmacokinetics, mechanisms of action and structural activity relationships of the compounds of the species. Future research should also focus on animal experiments aimed at assessing toxicity and clinical efficacy of species extracts.

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Conflict of Interest

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