Tanzania Journal of Science 50(4): 755-764, 2024
ISSN 0856-1761, e-ISSN 2507-7961
© College of Natural and Applied Sciences, University of Dar es Salaam, 2024

A review on Ethnomedical use of *Tephrosia vogelii* Hook.f. and its potentiality towards the development of antimicrobial agents and pesticides

Stephano Hanolo Mlozi[1, 2]*, Juma Mmongoyo[2] and Musa Chacha[1]
[1]*Nelson Mandela African Institution of Science and Technology, School of Life Science and Bioengineering, P.O. Box 447, Arusha, Tanzania*
[2]*University of Dar es Salaam, Mkwawa University College of Education, Department of Chemistry, P.O. Box 2513, Iringa, Tanzania*
**Corresponding author: stephano.hanolo@muce.ac.tz; or stephano.hanolo@udsm.ac.tz*
Received 8th Aug. 2024, Reviewed 30th Aug., Accepted 15th Oct., Published 30th Nov. 2024
https://dx.doi.org/10.4314/tjs.v50i4.4

Abstract

Fish bean, *Tephrosia vogelii* Hook.f is among of potential medicinal plant species in the genus Tephrosia. It has been traditionally used to cure human and animal ailments including fungal and bacterial diseases though not exhaustively scientifically reported. Similarly, its extracts have been locally used to control vectors and pests in small scale farming though the drug development from its extracts and phytochemicals is not reported. Thus, this review focused to unveil its ethnomedical and pharmaceutical potentiality with emphasis towards development of antimicrobial agents and pesticides. Data collection for the review was based on the published paper searched globally in several sources including Web of Sciences, Google scholar, and publishers such as Elsevier, Springer, Taylor and Francis. Evidently, data from literature revealed various bioactivity studies which uncovered potentiality of this species towards development of pesticides and antimicrobial agents. This review hereby promotes the present bioactive secondary metabolites of *Tephrosia vogelii*, and thought-provoking emphases on either herbal formulation or development of pesticides and antimicrobial agents. The reported pharmacological value of various secondary metabolites such as terpenoids, steroids, tannins, flavonoids and rotenoids explains potentiality of this medicinal plant. Moreover, data generated from this review on medicinal value of the *T. vogelii* offer and emphasizes medicinal consciousness towards development of pesticides and antimicrobial agents for improvement of human health settings and agricultural production particularly management of crop pests and diseases.

Key words: *Tephrosia vogelii*; antimicrobial agents; pesticide; medicinal plant; pests

Introduction

In the history of mankind, medicinal plants have been used since medieval times for the treatment and management of numerous human, animal and plant diseases (Dewick, 2009, Dubey & Sushma 2014, Jamshidi-Kia et al. 2018, Kunwar et al. 2019, Maregesi et al. 2007' Masevhe et al. 2015, Rahman & Parvin 2014, Rakotoarivelo et al. 2015, Runyoro et al. 2006, Tabassum & Hamdani 2014). This is because the medicinal plants have the capability to produce active phytochemical molecules that are capable of knocking down the disease-causing pathogens (Bhatt & Patel 2020, Dewick 2009, Lifongo et al. 2014, Simoben et al. 2018). Definitely, the medicinal use is considered among heritage cultures in some

communities. The humans have been exploiting this quality of medicinal plants for generations for treatment of human diseases (Bancessi et al. 2020, Ramamoorthy et al. 2019). According to WHO (2022), over 80% of global population, and the majority from low-income countries depends on medicinal plants to meet their primary healthcare to contain human ailments worldwide (WHO, 2002). Interestingly, this reliance on medicinal plants for containment of human diseases continues to date especially in the developing countries and was clearly observed in COVID-19 pandemic (Orhan & Senol Deniz 2020). Recently, following the outbreak of COVID-19 pandemic disease, many African countries including Tanzania paid special interest to medicinal plants (Makangara et al. 2023, Mlozi 2022). For instance, Madagascar deployed leaf juice of Neem while Tanzania used juice of mixed ginger, lemon and garlic which claimed to be able to treat COVID-19 virus (Mlozi 2022). Nonetheless, phytochemical components of the medicinal plants which are determined by geographical location and climate change have impacts on the medicinal values (Makangara et al. 2023).

Of special interest, this paper reviews in detail on the fish bean, *Tephrosia vogelii* Hook.f. a medicinal plant that ethnomedical evidences show for generations it has been used for treatment of infectious diseases and crop pests' management. The species has been reported as therapeutic source of an abortifacient, emetic, purgative agents, bactericides, antifungal agents, and anti-parasitic agents for treatment and management of pests, schistosomiasis, parasitic infections, ringworm and curing of skin diseases (Anjarwalla et al. 2015, Dzenda et al. 2008, Orwa et al. 2009). Likewise, pharmacological studies have revealed that extracts of crushed leaves of fish beans are potentially capable of killing lice, fleas, ticks, pest insects and larvae (Anjarwalla et al. 2015, Kidukuli et al. 2015). These medicinal potentials suggest that fish bean contain novel natural bioactive resources from which herbal formulations and/or drug development can be done for a wide range of therapeutic applications. For examples, such therapeutic applications are containment of human diseases and agricultural pesticides and insecticides. However, information on its usefulness has been scantily documented. Therefore, the present review focused on unveiling the potentiality of fish bean as a novel natural resource from which medicine for containment of human disease-causing pathogens could be formulated.

Overview of the *Tephrosia vogelii*

The fish bean (Figure 1 *vide infra*) belongs to phylum Tracheophyta, family Fabaceae, order Fabales, class Magnoliopsida, genus *Tephrosia*. and species *Tephrosia vogelii* (Mwaura et al. 2013, Stevenson & Belmain 2017). The *Tephrosia vogelii* has various trivial English names such as vogel's tephrosia, fish-poison-tree, fish-poison bean, and fish bean. In Swahili language, the fish bean is popularly known as *utupa*, *mtupa*, *mibaazi* and *kibazi*. The family Fabaceae in which *Tephrosia vogelii* belongs consists of more than 700 genera and about 20,000 species that grow in forms of trees, shrubs, vines, herbs and distributed worldwide (Ahmad et al. 2016, Rahman & Parvin 2014). Members of this Fabaceae family are universally known to possess potential medicinal values which are traditionally used to treat a range of human diseases including microbial infections (Ahmad et al. 2016, Rahman & Parvin 2014).

Plants in this Family are endowed with diverse biologically-active secondary metabolites such as terpenoids, saponins, flavonoids, alkaloids and coumarins, which have been reported to exhibit antimicrobial activities against pathogens and anticancer (Majinda et al. 2001, Makoshi & Arowolo 2011). Explicitly, the flavonoids have been reported for their antimicrobial activities, anticancer activities and activating neural-brain (Atanasov et al. 2015, Dewick 2009, Maheswari et al. 2016, Marinova et al. 2005, Pietta 2000, Prabha et al. 2014, Slimestad & Verheul 2009, Yao et al. 2004). Similarly, the tannins have been reported to exhibit anticancer activity, antimicrobial activities, and treatment of constipation (Hussain et al.

2019 Singh & Kumar 2019, Youn Hwang 2018). Additionally, the saponins have been reported to exhibit hepatopathy activity that assists body cells to recover from injuries (Patel et al. 2013). The fact that *Tephrosia vogelii* belongs to the family Fabaceae makes it an ideal ethnomedical candidate useful for investigating medicinal agents and drug formulations for treatment and management of diseases such as bacterial diseases, ecto-parasitic infections, schistosomiasis, ringworm and skin diseases (Anjarwalla et al. 2015, Dzenda et al. 2008, Mwaura et al. 2013, Orwa et al. 2009). The information on medicinal agents and drug formulations which could be used in the chemical industry to develop drugs for fighting the skin fungal infections, are limited and are needed to be unveiled.

Figure 1: The shrub of *Tephrosia vogelii* (Photo taken in the field in Arusha, Tanzania)

Distribution and traditional uses of *Tephrosia vogelii*

Tephrosia vogelii is a native plant in Western Africa and found in various tropical regions of Africa (Orwa et al. 2009). The species is exotic in China and various regions worldwide that include nearly all habitats including grassland, savannah-like vegetation, wasteland, forest margins and shrub land as well as fallow fields (Orwa et al. 2009). Among many uses, locally *T. vogelii* has been used as poison to stupefy fish for easy fish catching during fishing activities (Orwa et al. 2009). This use of the species caused the emanation of its popular common names as; "bean fish-poison-tree", "fish-poison bean" and "the fish bean". As a result, many people capitalized to grow *T. vogelii* for fishing purposes. However, authorities have banned its use as a fishing plant because use of *T. vogelii* is regarded as an illegal fishing method. The reason for banning might probably because the stupefying chemicals are unable to select specific sizes of the fishes such that they kill even baby-fishes thereby increasing the risk

of fish disappearance (Hisham et al. 2006, Makoshi & Arowolo 2011). Consequently, because of side effects in fishing activities the use of fish bean has been banned, this led its cultivation in many communities has also been drastically decelerating in the recent years.

Apart from being used as a fishing-plant, the root nodules of *T. vogelii* has been reported with capability to fixing atmospheric nitrogen, hence the plant contributes to the improvement of soil fertility (Orwa et al. 2009). In addition, some communities in East and West Africa have cultivated this plant for managing insects like weevils, ecto-parasites in animals and human ailments (Anjarwalla et al. 2015). It is unfortunately that over the recent years with the industrialization advancements, the local uses of *T. vogelii* as pesticides and acaricides were neglected and replaced by the petrochemical-derived industrial pharmaceuticals. Although conventional drugs have replaced the local ones, regrettably the petrochemical-derived drugs have nowadays been reported to be increasingly ineffective due to the fact that the pathogens are increasingly exerting resistance to the drugs. However, these petrochemical-derived drugs are not environmentally friendly. Therefore, these challenges exhibited by conventional drugs could be overcome by going back to the natural resources particularly medicinal plants that have been traditionally used for management of human diseases and crop pests.

Ethnomedical features of *Tephrosia vogelii*

Ethnomedically, this species is used as an abortifacient, emetic, bactericide, purgative and cure for skin diseases, schistosomiasis, ringworm and parasitic infections in various area including Tanzania, Uganda, Gabon, Zimbabwe, Angola, Nigeria and Kenya (Anjarwalla et al. 2015, Dzenda et al. 2008). The dry, crushed leaves are used as insecticide for management of lice, fleas and ticks (Anjarwalla et al. 2015). Leaf and root decoctions are used in the treatment of scabies and yaws, typhoid, constipation, tuberculosis as well as anthelmintic agents (Anjarwalla et al. 2015, Dzenda et al. 2008, Orwa et al. 2009).

Pharmacological value of *Tephrosia vogelii*

The pharmacological studies of water, methanolic and ethanolic extracts have substantiated the ethnomedical practice of *T. vogelii* as insecticides, acaricides, pesticides and dermatophyticide (Anjarwalla et al. 2015, Li et al. 2015, Makoshi & Arowolo 2011, Marango et al. 2017, Orwa et al. 2009, Stevenson & Belmain 2017). The bioactives of ethanolic and methanolic extracts reported to exhibit larvicidal effects on the subjected growth stages of mosquitoes and insects (Kalume et al. 2012, Kidukuli et al. 2015, Li et al. 2015, Stevenson & Belmain 2017). Pharmacological studies warranted for the application of *T. vogelii* extracts in management of ticks in domestic animals especially to small scale animal farming (Anjarwalla et al. 2015). Uganda, Tanzania, Kenya and Zimbabwe are among countries that their societies use leaf extracts to control ticks (Gadzirayi et al. 2009, Kalume et al. 2012, Makoshi & Arowolo 2011, Mwaura et al. 2013). Due to the fact of recounted insecticide and acaricides features, the species reveals its potentiality of contained bioactives for drug formulations and pharmaceutical agents (Stevenson & Belmain 2017).

Furthermore, pharmacological studies of leaves extracts of *T. vogelii* conducted by Makoshi and Arowolo (2011) and other studies validate its potentiality to cure animal skin infection (Dzenda et al. 2008, Makoshi & Arowolo 2011). In addition to that, the ethanolic-aqua (70:30) barks extracts of *T. vogelii* reported to exhibit antibacterial activity of the bacterial strains (Swamy et al. 2015). On the other hand, pharmacological studies of Swamy and colleagues (2015) pointed-out the usefulness of *T. vogelii* as medicinal plant for management of bacterial diseases (Inalegwu & Sodipo 2015, Swamy et al. 2015). The biological assay of ether-ethanolic extracts of *T. vogelii* seeds are reported to exhibit anti-oxidants and free scavenging properties, hence indicated the manifestation of flavonoids (Samuel et al.

2019). Other studies reported that the methanolic extracts of *T. vogelii* also exhibit antimicrobial activity (Mlozi et al. 2020) and purgative activity after subjected on the rabbit (Samuel et al. 2019). Moreover, methanolic extracts of *T. vogelii* stem bark reported with expectation of containing flavonoids exhibiting anti-cancer activity (Gbadamosi & Erinoso 2016).

The pharmacological studies advocate *T. vogelii* as potential source of the future pharmaceuticals drugs. Its usefulness ranges diversely not only as pesticides and acaricides but also antifungal, antibacterial and anticancer for human beings and other animals. Nevertheless, there is limited information due to lack or few studies conducted on the drug development hence compels prompt investigation of *T. vogelii* bioactives to seal the gap.

Secondary metabolites from *Tephrosia vogelii*

The phytochemical studies have spotlighted several secondary metabolites as shown in Figure 2 that were isolated from *T. vogelii*. Presence of the phytochemicals justifies the pharmacological importance of this medicinal plant. Such metabolites are classified as terpenoids, steroids, tannins, flavonoids and rotenoids (Inalegwu & Sodipo 2015, Makoshi & Arowolo 2011, Tesfaye Tole & Akino Neme 2019). For example, the terpenoids have predominantly been reported from aerial parts of the plant in the ethanol extracts, these include sesquiterpenes, (1β,6α,10α)-guai-4(15)-ene-6,7,10-triol1) (**1**) and lignans, (+)-lariciresinol 9'-stearate (**2**) (Wei et al., 2009). The flavonoids also have been reported from root methanolic extracts, these include obovatin 3-methylether (**3**) and Z-tephrostachin (**4**) (Dagne et al. 1989). Rotenoids have been reported from the roots, stem barks and leaves; such phytocompounds include deguelin (**5**), tephrosin (**6**), α-toxicarol (**7**), rotenone (**8**), 12α-hydroxyrotenone (**9**) and sarcolobine (**10**) (Stevenson et al. 2012; Stevenson & Belmain 2017). This information evidencing that *T. vogelii* is highly rich in compounds which are most likely account of its medicinal value.

Studies of pharmacological activities of compounds **1-10** revealed different levels of *T. vogelii* biological and chemical activities against pests and insects (Dagne et al. 1989, Stevenson et al. 2012, Stevenson & Belmain 2017, Wei et al. 2009). Bioactivity tests of the pure isolated secondary metabolites especially rotenoids and extracts justified the plant species being used as insecticides, pesticides and acaricides (Anjarwalla et al. 2015, Dagne et al. 1989, Gadzirayi et al. 2009, Kalume et al. 2012, Li et al. 2015, Makoshi & Arowolo 2011, Marango et al. 2017, Morris 1999, Mwaura et al. 2013, Russell et al. 2017, Stevenson et al. 2012, Stevenson & Belmain 2017). Rotenone has been the most active chemical component that influences its applicability as a natural source of local pesticides, acaricides and fish-stupefying agents. Excitingly, studies have indicated that the rotenones and other rotenoids are biodegradable because they decay easily and rapidly, mostly within fourteen days (Caboni et al. 2004, Ling, 2003). Therefore, the rotenoids are user-friendly to the environment. Indeed, the pharmacological studies do not only provide evidence for the potentiality of *T. vogelii* as a source of compounds of medicinal value but also easy compound-degradability suggests that the compounds have no contributions to the environmental pollution.

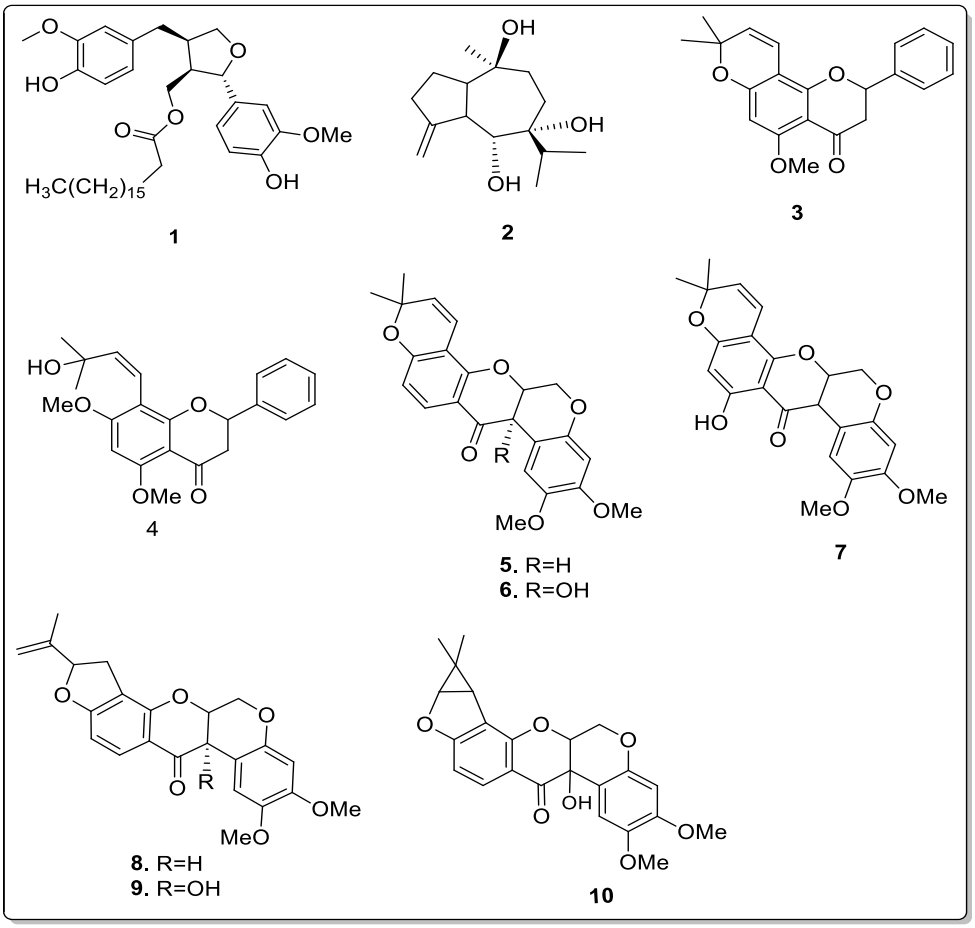

Figure 2: Reported phytocompounds from *Tephrosia vogelii*

Therefore, the ethnomedical use and pharmacological studies of the *T. vogelii* show that this species is an ideal potential source of bioactive secondary metabolites which could be used to develop pharmaceuticals/drug of a wide range of applications from agriculture production to the human health care. For instance, its extracts could be used for formulation of pesticides and antimicrobial agents. Despite its medicinal potential against pathogenic microbes and the abundant pharmacological knowledge of this precious plant on its potential to serve as a source of anti-ectoparasite and pesticide agents, there are no reports on the drug formulation from the plant. Also, phytochemical and biological assay investigations for antimicrobial activity of the stems, roots, fruits, flowers and leaves of the *T. vogelii* toxicity have not yet been exhaustively reported. Thus, this review builds an elevation concern on the extensive study to be carried out on the toxicity, phytochemical investigations and antimicrobial analysis of *T. vogelii* towards the development of antifungal and antibacterial formulations for treatment of both fungal and bacterial human infections. Hence, it emphasise more efforts on development of antimicrobial agents and pesticides from the fish bean.

Conclusion

The discovery of new bioactive secondary metabolites for drug development remains an urgent requirement to fight pests and ecto-parasites in agricultural production as well as combating infectious diseases affecting

human being. Drug discovery for neglected diseases such as African trypanosomiasis, ulcer, dengue fever; helminthiasis, sleeping sickness, soil-transmitted helminthes and fungal diseases is fundamental. For instance, the discovery and development of new antimicrobial agents may serve as therapeutics in combating bacterial and fungal diseases as they are more brutal causing deaths to many people with immuno-deficiency. The fact that *T. vogelii* synthesizes bioactive especially flavonoids, terpenes, saponins, tannins and rotenoids, suggests that this is an ideal medicinal plant upon studies searching bioactive compounds against plenty infectious diseases. Furthermore, reports from phytochemical and pharmacological studies may pave the way to drugs formulations that could be used against fungal and bacterial diseases ailments as well as pests management. Of course, it has noted that there is a need for more studies on the antifungal, antibacterial activities as well as cytotoxicity of *Tephrosia vogelii* which have not yet been thoroughly explored. This review exposes traditional uses as well as potentiality of *Tephrosia vogelii* and sensitizes herbal formulation and drug development, of which its bioactive has a great contribution for aggregate agricultural, biodiversity and ecosystem health in improving human livelihood.

Declaration

Authors declare that this manuscript is original, has not been published before and is not currently being considered for publication elsewhere. Authors confirm that the manuscript has been read and approved by all authors for publication.

Acknowledgement

Authors acknowledge contributions from reviewers' comments that aided to improve of this work.

Conflict of interest

The authors declare that there is no conflict of interest regarding this work.

References

Ahmad F, Anwar F, & Hira S 2016 Review on medicinal importance of fabaceae family. *Pharmacol. Online* 3: 151–156.

Anjarwalla P, Chepkoech D, Kinyanjui D, Belmain S, Jamnadass R, & Stevenson PC 2015 Kipeperushi cha mimea inayotumika kama dawa ya kudhibiti wadudu: Tephrosia vogelii Hook. f. In: *World Agroforestry Centre*. World Agroforestry Centre.

Atanasov AG, Waltenberger B, Pferschy-wenzig E, Linder T, Wawrosch C, Uhrin P, Temml V, Wang L, Schwaiger S, Heiss EH, Rollinger JM, Schuster D, Breuss JM, Bochkov V, Mihovilovic MD, Kopp B, Bauer R, Dirsch VM, & Stuppner H 2015 Discovery and resupply of pharmacologically active plant-derived natural products : A review. *Biotech. Adv*. 33(8): 1582–1614.

Bancessi A, Pinto MMF, Duarte E, Catarino L, & Nazareth T 2020 The antimicrobial properties of Moringa oleifera Lam. for water treatment: a systematic review. *SN Appl. Sci*. 2(3): 1–9.

Bhatt T & Patel K 2020 Carotenoids: Potent to Prevent Diseases Review. *Nat. Prod. Bioprospect*. 10(3): 109–117.

Caboni P, Sherer TB, Zhang N, Taylor G, Greenamyre JT, & Casida JE 2004 Rotenone, Deguelin, Their Metabolites, and the Rat Model of Parkinson's Disease. *Chem. Res. Toxicol*. 17(11): 1540–1548.

Dagne E, Yenesew A, & Waterman PG 1989 Flavonoids and isoflavonoids from Tephrosia fulvinervis and Tephrosia pentaphylla. *Phytochem.* 28(11): 3207–3210.

Dewick PM 2009 Medicinal Natural Product: A Biosynthetic Approach, 3rd Edition. John Wiley and Sons, Ltd.

Dubey M, & Sushma A 2014 Phytochemical status of some selected medicinal plants (*Eclipta alba*, *Cathranthus roseus* and *Swertia chirata*). *Asian J. Plant Sci. Res*, 4(5): 28–34.

Dzenda T, Ayo JA, Adelaiye AB, & Adaudi AO 2008 Ethno-medical and veterinary uses of *Tephrosia vogelii Hook. f.*: A Review. *Nigeria Vet. J.* 28(3): 24–39.

Gadzirayi CT, Mutandwa E, Mwale M, & Chindundu T 2009 Utilization of

Tephrosia vogelii in controlling ticks in dairy cows by small-scale commercial farmers in Zimbabwe. *Afr. J. Biotechnol.* 8(17): 4134–4136.

Gbadamosi IT, & Erinoso SM 2016 A review of twenty ethnobotanicals used in the management of breast cancer in Abeokuta, OgunState, Nigeria. *Afr. J. Pharm. Pharmacol.* 10(27): 546–564.

Hisham A, John S, Al-Shuaily W, Asai T, & Fujimoto Y 2006 (+)-Apollineanin: A new flavanone from *Tephrosia apollinea*. *Nat. Prod. Res.* 20(12): 1046–1052.

Hussain G, Huang J, Rasul A, Anwar H, Imran A, Maqbool J, Razzaq A, Aziz N, Makhdoom E, Konuk M, & Sun T 2019 Putative roles of plant-derived tannins in neurodegenerative and neuropsychiatry disorders: An updated review. *Molecules* 24: 1–16.

Inalegwu B & Sodipo OA 2015 Antimicrobial and foam forming activities of extracts and purified saponins of leaves of Tephrosia vogelii. *Eur. J. Experiment. Biol.* 5(5): 49–53.

Jamshidi-Kia F, Lorigooini Z & Amini-Khoei H 2018 Medicinal plants: Past history and future perspective. *J. HerbMed Pharmacol.* 7: 1–7.

Kalume MK, Losson B, Angenot L, Tits M, Wauters JN, Frédérich M, & Saegerman C 2012 Rotenoid content and in vitro acaricidal activity of Tephrosia vogelii leaf extract on the tick Rhipicephalus appendiculatus. *Vet. Parasitol.* 190: 204–209.

Kidukuli AW, Maregesi SM, Saria J, Otieno NJ, Lawi Y, Nondo RS, Innocent EM, Mlimbila J, Mihale J, & Moshi MJ 2015 Larvicidal efficacy of some Tephrosia species extracts against *Anopheles Gambiae* Ss and *Culex Quinquefasciatu*s Say. *Spatula DD* 5(1): 21–25.

Kunwar RM, Shrestha K, Malla S, Acharya T, Sementelli AJ, Kutal D, Bussmann RW & Bussmann W 2019 Relation of medicinal plants , their use patterns and availability in the lower Kailash Sacred. *Ethnobot. Res. Appl.* 527: 1–2.

Li W, Huang C, Wang K, Fu J, Cheng D & Zhang Z 2015 Laboratory evaluation of aqueous leaf extract of *Tephrosia vogelii* against larvae of Aedes albopictus (Diptera: Culicidae) and non-target aquatic organisms. *Acta Tropica 146*: 36–41.

Lifongo LL, Simoben CV, Ntie-Kang F, Babiaka SB & Judson PN 2014 A Bioactivity Versus Ethnobotanical Survey of Medicinal Plants from Nigeria, West Africa. *Nat. Prod. Bioprospect.* 4(1): 1–19.

Ling N 2003 Rotenone - a review of its toxicity and use for fisheries management. *Science for Conservation 211*. Department of Conservation.

Maheswari U, Sangeetha KS, Umamaheswari S, Uma C, Reddy M & Kalkura SN 2016 Flavonoids: Therapeutic Potential of Natural Pharmacological Agents. *Int. J. Pharm. Sci. Res.* 7(10): 3924–3930.

Majinda RRT, Abegaz BM, Bezabih M, Ngadjui BT, Wanjala CCW, Mdee, L. K., Bojase, G., Silayo, A., Masesane, I., & Yeboah, S. O. (2001). Recent results from natural product research at the University of Botswana. *Pure Appl. Chem.* 73(7): 1197–1208.

Makangara JJ, Mshandete AM, Mbega ER, Nyika JR, Mbago F, Ndilanha EG, Nyika RJ & Nyika JJ 2023 Review on the secondary metabolites, biological properties, and ethnomedicinal uses of the component species of the Buheri wa Afya formula used to treat COVID-19 in Tanzania. *Phytomed. Plus*, 4(1): 1–18.

Makoshi M & Arowolo ROA 2011 Therapeutic effects of *Tephrosia vogelii* ointment in the treatment of bovine dermatophilosis. *J. Vet. Med. Animal Health* 3(4): 51–55.

Marango SN, Khayeka-Wandabwa C, Makwali JA, Jumba BN, Choge JK, Adino EO & Anjili CO 2017 Experimental therapeutic assays of *Tephrosia vogelii* against Leishmania major infection in murine model: In vitro and in vivo. *BMC Res. Notes* 10(1): 1–12.

Maregesi SM, Ngassapa OD, Pieters L & Vlietinck AJ 2007. Ethnopharmacological survey of the Bunda district, Tanzania: Plants used to treat infectious diseases. *J.*

Ethnopharmacol. 113(3): 457–470.

Marinova D, Ribarova F & Atanassova M 2005 Total phenolics and flavonoids in Bulgarian fruits and vegetables. *J. Univ. Chem. Technol. Metal.* 40(3): 255–260.

Masevhe NA, McGaw LJ & Eloff JN 2015 The traditional use of plants to manage candidiasis and related infections in Venda, South Africa. *J. Ethnopharmacol.* 168: 364–372.

Mlozi SH 2022 The role of natural products from medicinal plants against COVID-19: traditional medicine practice in Tanzania. *Heliyon* 8(6): e09739.

Mlozi SH, Mmongoyo JA & Chacha M 2020 Antimicrobial activities of *Tephrosia vogelii* against selected pathogenic fungi and bacteria strains. *Mycology* 11(1): 49–55.

Morris JB 1999 Legume genetic resources with novel "value added" industrial and pharmaceutical use. *Proceedings Fourth National Symposium New Crops and New Uses: Biodiv. Agric. Sustain.* (pp196–201).

Mwaura L, Stevenson PC, Ofori DA, Anjarwalla P & Jamnadass R 2013 *Pesticidal Plant Leaflet: Tephrosia vogelii Hook.f.* World Agroforestry Centre; World Agroforestry Centre.

Orhan IE & Senol Deniz, FS 2020 Natural Products as Potential Leads Against Coronaviruses: Could They be Encouraging Structural Models Against SARS-CoV-2? *Nat. Prod. Bioprospect.* 10(4): 171–186.

Orwa C, Mutua A, Kindt R, Jamnadass R & Anthony S 2009 *Tephrosia vogelii Hook.f. Fabaceae - Papilionoideae*. Agroforestry Database.

Patel S, Nag MK, Daharwal SJ, Singh MR & Singh D 2013 Plant toxins: an overview. *Res. J. Pharmacol. Pharmacodynam.* 5(5): 283–288.

Pietta P 2000 Flavonoids as Antioxidants. *J. Nat. Prod.*, *63*: 1035–1042.

Prabha DS, Dahms HU, & Malliga P 2014 Pharmacological potentials of phenolic compounds from *Prosopis* spp.: A review. *J. Coast. Life Med.* 2(11): 918–924.

Rahman AH & Parvin MIA 2014 Study of Medicinal Uses on Fabaceae Family at Rajshahi, Bangladesh. *Res. Plant Sci.* 2(1): 6–8.

Rakotoarivelo NH, Rakotoarivony F, Ramarosandratana AV, Jeannoda VH, Kuhlman AR, Randrianasolo A & Bussmann RW 2015 Medicinal plants used to treat the most frequent diseases encountered in Ambalabe rural community, Eastern Madagascar. *J. Ethnobiol. Ethnomed.* 11(68): 1–16.

Ramamoorthy R, Muthalagu M, Andra S, Ravichandran B & Narayanasamy M 2019 Investigation on antimicrobial, antioxidant and cytotoxicity properties of triple bark extract formulated using traditional medicinal plants. *SN Appl. Sci.*, *1*(7): 1–7.

Runyoro DKB, Ngassapa OD, Matee MIN, Joseph CC & Moshi MJ 2006 Medicinal plants used by Tanzanian traditional healers in the management of Candida infections. *J. Ethnopharmacol.* 106(2): 158–165.

Russell DA, Freudenreich JJ, Ciardiello JJ, Sore HF & Spring DR 2017 Stereocontrolled semi-syntheses of deguelin and tephrosin. *Org. Biomol. Chem.* 15(7): 1593–1596.

Samuel VJ, Mahesh AR & Murugan V 2019 Phytochemical and pharmacological aspects of Tephrosia genus: A brief review. *J. Appl. Pharmaceut. Sci.* 9(3): 117–125.

Simoben CV, Ntie-Kang F, Akone SH & Sippl W 2018 Compounds from African Medicinal Plants with Activities Against Selected Parasitic Diseases: Schistosomiasis, Trypanosomiasis and Leishmaniasis. *Nat. Prod. Bioprospect/.* 8(3): 151–169.

Singh AP & Kumar S 2019 Applications of Tannins in Industry. In *Tannins - Structural Properties, Biological Properties and Current Knowledge* (pp. 1–19).

Slimestad R & Verheul M 2009 Review of flavonoids and other phenolics from fruits of different tomato (*Lycopersicon esculentum* Mill.) cultivars. *J. Sci. Food. Agric.* 89: 1255–1270.

Stevenson PC & Belmain SR 2017 *Tephrosia vogelii:* a pesticide of the future for African farming. *Boletín SEEA*, 2: 19–22.

Stevenson PC, Kite GC, Lewis GP, Forest F, Nyirenda SP, Belmain SR, Sileshi GW & Veitch NC 2012 Distinct chemotypes of *Tephrosia vogelii* and implications for their use in pest control and soil enrichment. *Phytochemistry* 78: 135–146.

Swamy AT, Obey JK, Erick T & Edwin MO 2015 In vitro antibacterial activity of ethanolic-aqua extract of *Tephrosia vogelii* bark against laboratory strains of selected microorganisms. *Baraton Interdiscipl. Res. J.* 5: 133–139.

Tabassum N & Hamdani M 2014 Plants used to treat skin diseases. *Pharmacogn. Rev.* 8(15): 52–61.

Tesfaye TT & Akino NB 2019 Chemical Studies of *Tephrosia vogelii* and *Commiphora schimperi* Occurring in Ethiopia. *Modern Chemistry*, *7*(3): 45–53.

Wei HH, Xu HH, Xie HH, Xu LX & Wei XY 2009 Sesquiterpenes and lignans from Tephrosia vogelii. *Helv. Chim. Acta* 92(2): 370–374.

WHO 2002 WHO Traditional Medicine Strategy 2002-2005. In: *World Health Organisation* (pp. 1–74).

Yao LH, Jiang YM, Shi J, Thomas-barberan FA, Datta A, Chen S & Singanusong R 2004 Flavonoids in Food and Their Health Benefits. *Plant Foods Human Nutr. 59*: 113–122.

Youn Hwang D 2018 Therapeutic Role of Natural Products Containing Tannin for Treatment of Constipation. In: *Constipation* (pp. 1–19). IntechOpen.