Science Arena Publications
Specialty Journal of Chemistry
ISSN: 2521-3164
Available online at www.sciarena.com
2019, Vol, 4 (3): 7-14

A Review on African Violet Tree (*Securidaca longipedunculata*) : A Traditional Drug with Multiple Medicinal Uses

Abubakar US[1]*, Danmalam UH[2], Ibrahim H[2], Maiha BB[3]

[1] Bioresources Development Centre, Kano. National Biotechnology Development Agency (NABDA), Abuja, Nigeria.
[2] Department of Pharmacognosy and Drug Development, Ahmadu Bello University, Zaria, Nigeria.
[3] Department of Pharmacology and Therapeutics, Ahmadu Bello University, Zaria, Nigeria.

*** Corresponding Author**

Abstract: *Securidaca longipedunculata Fresen is a plant species with numerous medicinal uses, which is widely distributed in tropical and subtropical areas of Africa. The present wok summarizes its traditional uses, toxicity, biological activities, phytochemical constituents and conservation status. The plant was found to be toxic at higher concentrations; particularly the root bark and whole root extracts. The biological activities of the plant include antiinflammatory, antioxidant, antiparasitic, histopathological, antimicrobial, antidiabetic, antiplasmodial, antitrypanosomal, anticonvulsant, enzyme inhibition, insecticidal, molluscicidal and pesticidal activities. Different classes of bioactive compounds which include phenolic acids, xanthones, glycosides, saponins, steroids, fatty acids, volatile oils, flavonoids, alkaloids and sucrose derivatives were isolated from different parts of Securidaca longipedunculata. This important medicinal plant is threatened by over harvesting; this may be due to the fact that the root is the most commonly used part, which makes the plant difficult to survive over harvesting, therefore, there is need by all stakeholders in Africa to initiate conservation program to save the plant. Also, the pharmacology and phytochemistry of the leaves and stem bark of the violet tree should be further investigated.*

Keywords: *Securidaca longipedunculata, traditional uses, toxicity, biological activities, phytochemical constituents, conservation*

INTRODUCTION

Securidaca longipedunculata Fresen belongs to the family Polygalaceae, it is a small tree with alternate leaves which are variable in size, shape and crowded towards the stem tips (Van Wyk *et al.*, 2009). Its flowers are small, pink or purple in colour, sweet scented and are usually produced in early summer (Van Wyk *et al.*, 2005). The fruits of this plant are heavily veined, smooth, oblong, purplish green when young and also possess a membranous wing (Coates-Palgrave, 2005).

It is locally known as Uwar magunguna or Sanya (Hausa), Ipeta (Yoruba), Alali (Arabic) and Umfufu (Swahili), while its common names include Violet tree, Fibre tree and Rhodesian violet. The plant is widely distributed in tropical and subtropical areas of Africa, this include Angola, Benin, Botswana, Cameroon, Chad, Eritrea, Ethiopia, Gambia, Ghana, Kenya, Malawi, Namibia, Niger, Nigeria, Rwanda, Senegal, South Africa, Sudan, Tanzania, Uganda, Zambia etc (Baloyi and Tshisikhawe, 2009; Tshisikhawe *et al.*, 2012).

Although, *S. longipedunculata* is protected under provincial and national legislation in many countries, but it is still one of the most traded medicinal plants in African continent (Moeng, 2010; Tabuti *et al.*, 2012). This important medicinal plant is threatened by over harvesting; this may be due to the fact that the root is the most commonly used part, which makes the plant difficult to survive over harvesting. Other factors include urbanization, expansion of agricultural activities, anthropogenic and environmental conditions such bush fires, droughts etc. (Oni *et al.*, 2014; Abubakar *et al.*, 2018a). The Royal Botanic Gardens also listed the plant in their "adopt a seed, save a species campaign" in order to protect it from becoming endangered and/or extinct (KRBG, 2013).

Plate I: *Securidaca longipedunculata* in its Natural Habitat

Plate II: Leaves and Flowers of *Securidaca longipedunculata*

Traditional Uses of *S. longipedunculata*

The root of this plant is traditionally used to manage fungal infections, fever, malaria, gonorrhoea, headaches, cancer, rheumatism, tuberculosis, diabetes, venereal diseases, syphilis, sexual impotence, toothache, pains, epilepsy, convulsions, constipation, pneumonia, backache, blood purification, sexually transmitted infections, skin infections and also used as an aphrodisiac (Moshi *et al.*, 2007; Viol, 2009; Maroyi, 2013; Mustapha, 2013). Also, leaf of *S. longipedunculata* is locally used to treat epilepsy, headaches, stomach ache, infertility, snakebite, toothache, cancer, skin infections, dislocated jaw, contraceptive purposes and to expel the placenta (Mustapha, 2013), while its stem bark is traditionally used to treat epilepsy, stomach ache, venereal diseases, skin diseases, dysentery, malaria, typhoid, inflammation, chest complaints, abortion, constipation, viral infections, snake bites and infertility problems (Das, 2009; Bruschi *et al.*, 2011; Oladunmoye and Kehinde, 2011; Borokini *et al.*, 2013; Kadiri *et al.*, 2013).

The whole plant is used to wash the mouth and treat infections such as oral candidiasis, excessive coughing and other opportunistic infections associated with Human Immunodefiency Virus (Chinsembu and Hedimbi, 2010).

The roots or pounded seeds of *S. longipedunculata* can be used as soap and for bleaching items. A fibre obtained from the inner bark can be used like cotton to weave a coarse cloth, fishing nets and baskets. The plant is also used for hut construction, brooms, poles etc (Van Wyk and Gericke, 2000).

Toxicological Studies

The medial lethal dose (LD_{50}) of the ethyl acetate stem bark extract of *S. longipedunculata* was greater than 5, 000 mg/k g body weight, while that of aqueous stem bark extract was found to be above 2, 000 mg/kg body weight (Abubakar *et al.*, 2018b). Also, the acute toxicity studies of the aqueous whole root extract of the plant revealed LD_{50} values of 1740 mg/kg and 20 mg/kg body weight for oral and intraperitoneal application routes respectively (Adeyemi *et al.*, 2010), while Dapar et al (2007) and (Keshebo et al (2014) reported LD_{50} values of 37 mg/kg and 547 mg/kg body weight for aqueous and ethanol root extracts respectively. However, death was not recorded when different doses (300, 900 and 2700 mg/kg body weight) of the aqueous root extract were orally administered on a daily basis for 28 days (Etuk *et al.*, 2006).

Biological Activities of *S. longipedunculata*

The leaf and root bark extracts were reported to have antibacterial and antifungal activities (Karou *et al.*, 2012; Musa *et al.*, 2013; Ndamitso *et al.*, 2013). Also, the stem bark extract of this important plant was active against clinical bacterial isolates of *Escherichia coli, Salmonella typhi, Staphylococcus aureus, Shigella dysenteriae, Pseudomonas aeruginosa* and *Klebsiella pneumonia*; the study supported the use of *S. longipedunculata* stem bark in the management of bacterial diseases and as such could serve as a potential source of antibacterial drugs. (Abubakar *et al.*, 2018c). However, studies reported by other workers revealed that *S. typhi* and *P. aeruginosa* were resistant to the chloroform, methanol and aqueous root extract of *S. longipedunculata*, and this suggests that the stem bark contains more antibacterial agents than the other parts of the violet tree (Gbadamosi, 2012; Ndamitso *et al.*, 2013).

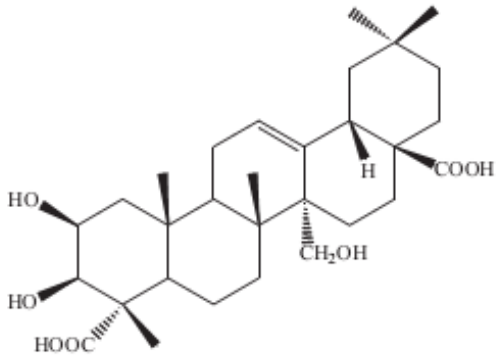
On the other hand, the methanol extract from the root inhibited motility of *Trypanosoma brucei brucei* and *Trypanosoma congolense* (Atawodi *et al.*, 2003), while the petroleum ether extract from the stem bark inhibited motility of *Trypanosoma brucei* (Atawodi, 2005). It was also reported that aqueous and methanol extracts of the root bark showed strong antitrypanosomal activity against *Trypanosoma brucei rhodesiense* (Freiburghaus *et al.*, 1996); larvicidal effect against *Heligmosomoides contortus* and *Heligmosomoides polygyrus* (Adiele et al., 2013). The root bark and leaf extracts were also reported to have antioxidant (Muanda *et al.*, 2010; Karou *et al.*, 2012) and antiplasmodial activities (Bah *et al.*, 2007; Haruna *et al.*, 2013). The methanol root bark extracts showed good antiinflammatory activity (Muanda *et al.,* 2010), while the insecticidal, molluscicidal and pesticidal properties of the root bark, stem bark and leaf extracts were reported by many workers (Boeke *et al.*, 2004; Olofintoye, 2010; Afful *et al.*, 2012; Eziah *et al.*, 2013).

Also, the methanol extract of the root exhibited enzyme inhibition against acetylcholinesterase, carboxylesterase and xanthine oxidase (Bangou *et al.*, 2011). The anticonvulsant, anxiolytic and sedative activities were reported by Adeyemi et al (2010) and Okomolo et al (2011).

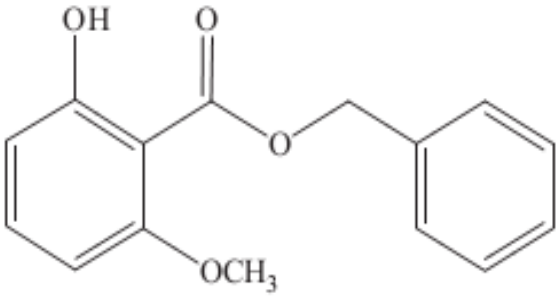
Phytochemical Constituents of *S. longipedunculata*

Preliminary phytochemical screening revealed the presence of alkaloids, cardiac glycosides, flavonoids, saponins, tannins, volatile oils, terpenoids, carbohydrates, phenolic compounds and steroids in different extracts of leaf, root bark and stem bark of the violet tree (Auwal *et al.*, 2012; Gbadamosi, 2012; Abdullahi *et al.*, 2019).

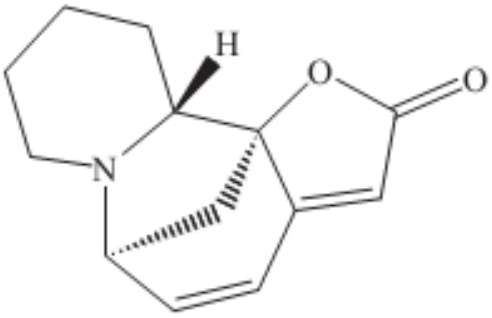
Some of the compounds isolated from the root of the plant include quercetin dehydrate, p-coumaric acid, gallic acid, chlorogenic acid, rutin, cinnamic acid, presenegenin [1], apigenin, quercetin glucosyl, caffeic acid, epicatechic acid, benzyl 2-hydroxy-6-methoxybenzoate [2], 6-hydroxy-2-methoxy benzoic acid, 1,6,8-trihydroxy-2,3,4,5-tetramethoxyxanthone, 1,6-dihydroxy-2,3,4,5,8-pentame-thoxyxanthone, 8-hydroxy-1,4,5,6-tetramethoxy-2,3-methylene-dioxyxanthone-4,6,8-trihydroxy,1,2,3,5-tetramethoxyxanthone and Muchimangins A, B, C and D, which are highly oxygenated xanthones (Muanda *et al.*, 2010; Dibwe *et al.*, 2012). Securinine [3], ß-Sitosterol [4], Quercetin-3-O-D-xyloside, 1, 7-dihydroxy-4- methoxyxanthone [5], methyl salicylate, 1,6,8-trihydroxy-2,3,4,7-tetra-methoxyxanthone [6] and 5-O-prenyl-1-hydroxy-3, 4, 6, 7, 8-pentamethoxyxanthone [7] were also isolated from the leaves and root of this important medicinal plant (Debella *et al.*, 2000; Lognay *et al.*, 2000; Jayasakara *et al.*, 2002; Van Wyk *et al.*, 2005; Meli *et al.*, 2007). Similarly,3-O-ß-D-glucopyranosylpresenegenin-28-O-ß-D-apiofuranosyl-(1-3)-ß-D-xylopyranosyl-(1-4)-[ß-D-apiofuranosyl-(1-3)]-α-L-rhamnopyranosyl-(1-2)-{4-O-[(E)-3,4,5-trimethoxy cinnamoyl]}-ß-D-fucopyrano ester and other related compounds were isolated from the methanol root extract of *S. longipedunculata* (Mitaine-Offer *et al.*, 2010).



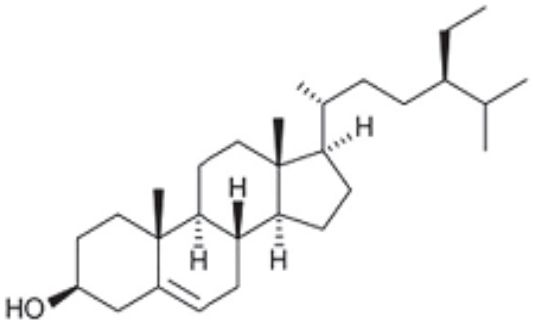
[1]



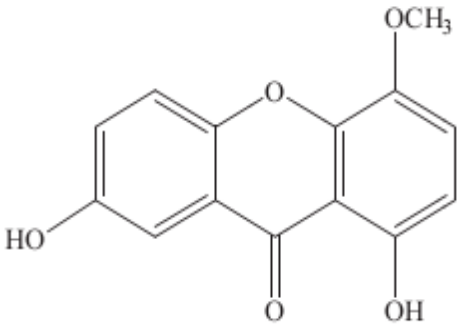
[2]



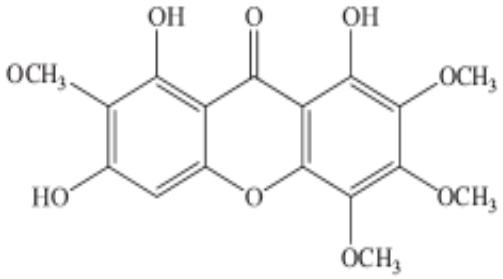
[3]



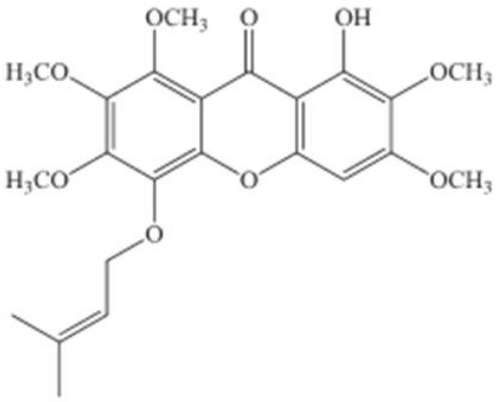
[4]



[5]



[6]



[7]

Figure 1: Chemical Structures of some Compounds Isolated from *S. longipedunculata*

Conclusion

The present work has emphasized that *S. longipedunculata* is one of the most important medicinal plants in African traditional medicine. Biological studies have supported the traditional uses of this plant; therefore, it could serve as a potential source of many drugs of plant origin. There is need by all stakeholders in Africa to initiate conservation program to save this plant from becoming endangered and/or extinct. Finally, the pharmacology and phytochemistry of the leaves and stem bark of the plant should be further investigated.

References

1. Abdullahi, M. S., Abubakar, U. S., Safiyanu, I., Hadiza, R. J., Sa'adatu, A. U., & Jamila, G. A. (2019). Phytochemical analysis and accumulation of heavy metals in some common medicinal plants. *Journal of Pharmacognosy and Phytochemistry*, *8*(3), 2692-2696.
2. Abubakar U. S., Abdullahi, M. S., Abdulrazak, A., Fatima, A., Joseph, M., & Sagir, H. (2018). Acute toxicity studies and phytochemical screening of aqueous and ethyl acetate stem bark extracts of *Securidaca longipedunculata* Fresen (Polygalaceae). *International Journal of Pharmacological Research*, *8*(10), 104-107.
3. Abubakar, U. S., Abdullahi, M. S., Hadiza, R. J., Joseph, M., Binta, I. K., & Habiba, G. U. (2018). Antibacterial activity of *Securidaca longipedunculata* stem bark against some clinical bacterial isolates. *Journal of Pharmacognosy and Phytochemistry*, *7*(6), 1967-1970.
4. Abubakar, U. S., Khalifa, B. I., Abdu, F., Sanusi, M., Gawuna, T. A., Adamu, J. G., & Rogo, S. S. (2018). Threatened Medicinal Plants of Kano Flora and the Need for Urgent Conservation. *International Journal of Conservation Science*, *9*(1), 173-178.

5. Adeyemi, O. O., Akindele, A. J., Yemitan, O. K., Aigbe, F. R., & Fagbo, F. I. (2010). Anticonvulsant, anxiolytic and sedative activities of the aqueous root extract of Securidaca longepedunculata Fresen. *Journal of ethnopharmacology*, *130*(2), 191-195.
6. Adiele, R. C., Fakae, B. B., & Isuzu, I. U. (2013). Anthelmintic activity of Securidaca longepedunculata (Family: Polygalaceae) root extract in mice, in vitro and in vivo. *Asian Pacific journal of tropical medicine*, *6*(11), 841-846.
7. Afful, E., Owusu, E. O., & Obeng-Ofori, D. (2012). Bioactivity of Securidaca longepedunculata Fres. against Callosobruchus maculatus Fab.(Coleoptera: Bruchidae) and Sitophilus zeamais Motsch (Coleoptera: Curculionidae). *International Journal of Agricultural Science Research*, *1*(3), 046-054.
8. Atawodi, S. E. (2005). Comparative in vitro trypanocidal activities of petroleum ether, chloroform, methanol and aqueous extracts of some Nigerian savannah plants. *Afr. J. Biotechnol*, 4, 177-182.
9. Atawodi, S. E., Bulus, T., Ibrahim, S., Ameh, D. A., Nok, A. J., Mamman, M., & Galadima, M. (2003). In vitro trypanocidal effect of methanolic extract of some Nigerian savannah plants. *African Journal of Biotechnology*, *2*(9), 317-321.
10. Auwal, S. M., Atiku, M. K., Wudil, A. M., & Sule, M. S. (2012). Phytochemical composition and acute toxicity evaluation of aqueous root bark extract of *Securidaca longipedunculata* (Linn). *Bayero Journal of Pure and Applied Sciences*, *5*(2), 67-72.
11. Bah, S., Jäger, A. K., Adsersen, A., Diallo, D., & Paulsen, B. S. (2007). Antiplasmodial and GABAA–benzodiazepine receptor binding activities of five plants used in traditional medicine in Mali, West Africa. *Journal of ethnopharmacology*, *110*(3), 451-457.
12. Baloyi, O., & Tshisikhawe, M. P. (2009). The population ecology of Securidaca longepedunculata Fresen. in Nylsvley Nature Reserve, Limpopo Province, RSA. *South African Journal of Botany*, *2*(75), 430.
13. Boeke, S. J., Baumgart, I. R., Van Loon, J. J. A., Van Huis, A., Dicke, M., & Kossou, D. K. (2004). Toxicity and repellence of African plants traditionally used for the protection of stored cowpea against Callosobruchus maculatus. *Journal of Stored Products Research*, *40*(4), 423-438.
14. Borokini, T. I., Clement, M., Dickson, N. J., & Edagbo, D. E. (2013). Ethnobiological survey of traditional medicine practice for circulatory and nervous system related diseases in Oyo State, Nigeria. *J Herb Med*, *2*(6), 111-20.
15. Bruschi, P., Morganti, M., Mancini, M., & Signorini, M. A. (2011). Traditional healers and laypeople: a qualitative and quantitative approach to local knowledge on medicinal plants in Muda (Mozambique). *Journal of Ethnopharmacology*, *138*(2), 543-563.
16. Chinsembu, K. C., & Hedimbi, M. (2010). An ethnobotanical survey of plants used to manage HIV/AIDS opportunistic infections in Katima Mulilo, Caprivi region, Namibia. *Journal of ethnobiology and ethnomedicine*, *6*(1), 25.
17. Coates-Palgrave, M. (2005). Keith Coates-Palgrave Trees of Southern Africa, Struik Publishers. *Cape Town*, 458-459.
18. Dapar, M. L., Aguiyi, J. C., Wannang, N. N., Gyang, S. S., & Tanko, N. M. (2007). The histopathologic effects of Securidaca longepedunculata on heart, liver, kidney and lungs of rats.
19. Das, K. (2009). Medicinal plants for snake bite treatment-future focus. *Ethnobotanical Leaflets*, *2009*(4), 11.
20. Debella, A., Kunert, O., Schmid, M. G., Michl, G., Bucar, F., Abebe, D., & Haslinger, E. (2000). A diterpene, a flavonol glycoside, and a phytosterol glycoside from *Securidaca longipedunculata* and Entada abyssinica. *Monatshefte für Chemie/Chemical Monthly*, *131*(4), 401-408.
21. Dibwe, D. F., Awale, S., Kadota, S., & Tezuka, Y. (2012). Muchimangins A–D: novel diphenylmethyl-substituted xanthones from Securidaca longepedunculata. *Tetrahedron Letters*, *53*(46), 6186-6190.
22. Etuk, E., Adebiyi, R., Elsa, A., & Agaie, B. (2006). Acute and subchronic (28-day) oral toxicity studies of the aqueous extract of Securidaca longepedunculata Fresen (Polygalceae) in mice. *International Journal of Pharmacology*, *2*(4), 421-425.

23. Eziah, V. Y., Buxton, T., & Owusu, E. O. (2013). Bioefficiency of Zanthoxylum xanthoxyloides and Securidaca longepedunculata against Prostephanus truncates (Horn) (Coleoptera: Bostrichidae) and Tribolium castaneum (Herbst) (Coleoptera: Tenebrionidae). *J. biopesticides*, 6: 54-62.
24. Freiburghaus, F., Kaminsky, R., Nkunya, M. H. H., & Brun, R. (1996). Evaluation of African medicinal plants for their in vitro trypanocidal activity. *Journal of ethnopharmacology*, *55*(1), 1-11.
25. Gbadamosi, I. T. (2012). Evaluation of antibacterial activity of six ethnobotanicals used in the treatment of infectious diseases in Nigeria. *Botany Research International*, *5*(4), 83-89.
26. Haruna, Y., Kwanashie, H. O., Anuka, J. A., Atawodi, S. E., & Hussaini, I. M. (2013). In vivo anti-malarial activity of methanol root extract of Securidaca longepedunculata in mice infected with Plasmodium berghei. *International Journal of Modern Biology and Medicine*, *3*(1), 7-16.
27. Jayasekara, T. K., Stevenson, P. C., Belmain, S. R., Farman, D. I., & Hall, D. R. (2002). Identification of methyl salicylate as the principal volatile component in the methanol extract of root bark of Securidaca longepedunculata Fers. *Journal of Mass Spectrometry*, *37*(6), 577-580.
28. JeanBangou, M., Kiendrebeogo, M., Meda, N. T. R., & Coulibaly, A. Y. (2011). Evaluation of enzymes inhibition activities of medicinal plant from Burkina Faso. *Pakistan Journal of Biological Sciences*, *14*(2), 99-105.
29. Kadiri, A. B., Agboola, O. M., & Fashina, F. O. (2013). Ethnobotanical survey and phyto-anatomical studies of some common plants used for the treatment of epilepsy in some rural areas of South west Nigeria. *Journal of Pharmacognosy and Phytochemistry*, *2*(4), 175-182.
30. Karou, S. D., Tchacondo, T., Tchibozo, M. A. D., Anani, K., Ouattara, L., Simpore, J., & De Souza, C. (2012). Screening Togolese medicinal plants for few pharmacological properties. *Pharmacognosy research*, *4*(2), 116.
31. Keshebo, D. L., Choundhury, M. K., & Dekebo, A. H. (2014). Investigation on toxicity, hypoglycemic effect of the root bark of *Securidaca longipedunculata* Fresen (Polygalaceae) and determination of heavy metals. *Annals of Biological Research*, *5*(6), 15-19.
32. KRBG. (2013). Help Us Save African Violet Tree, Support Kew. *Kew Royal Botanical Gardens*.
33. Lognay, G., Marlier, M., Seck, D., & Haubruge, É. (2000). The Occurrence of 2-hydroxy-6-methoxybenzoic Acid Methyl Ester in *Securidaca longipedunculata* Fresen Root Bark. *Biotechnol Agron Soc Environ*, 4: 107-110.
34. Maroyi, A. (2013). Traditional use of medicinal plants in south-central Zimbabwe: review and perspectives. *Journal of ethnobiology and ethnomedicine*, *9*(1), 31.
35. Meli, A. L., Ngninzeko, F. N., Castilho, P. C., Wansi, J. D., Kuete, V., Lontsi, D., ... & Sondengam, B. L. (2007). Securidacaxanthones B and C, xanthones from Securidaca longepedunculata (Polygalaceae). *Planta Medica*, *73*(09), P_411.
36. Mitaine-Offer, A. C., Pénez, N., Miyamoto, T., Delaude, C., Mirjolet, J. F., Duchamp, O., & Lacaille-Dubois, M. A. (2010). Acylated triterpene saponins from the roots of Securidaca longepedunculata. *Phytochemistry*, *71*(1), 90-94.
37. Moeng, T. E. (2010). *An investigation into the trade of medicinal plants by muthi shops and street vendors in the Limpopo Province, South Africa* (Doctoral dissertation).
38. Moshi, M. J., van den Beukel, C. J., Hamza, O. J., Mbwambo, Z. H., Nondo, R. O., Masimba, P. J., ... & van der Ven, A. J. (2007). Brine shrimp toxicity evaluation of some Tanzanian plants used traditionally for the treatment of fungal infections. *African Journal of Traditional, Complementary and Alternative Medicines*, *4*(2), 219-225.
39. Muanda, F. N., Dicko, A., & Soulimani, R. (2010). Assessment of polyphenolic compounds, in vitro antioxidant and anti-inflammation properties of Securidaca longepedunculata root barks. *Comptes rendus biologies*, *333*(9), 663-669.

40. Musa, A. A., Oyewale, A. O., Ndukwe, I. G., Yakubu, S. E., & Abdullahi, M. S. (2013). Phytochemical screening and antimicrobial activity of solvent fractions of Securidaca longepedunculata (Fresen) root bark methanol extract. *Journal of Chemical and Pharmaceutical Research*, *5*(10), 28-33.
41. Mustapha, A. A. (2013). Ethno-medico-botanical uses of Securidaca longepedunculata Fresen (Family-Polygalaceae) from Keffi Local Government, Nasarawa State, Nigeria. *Journal of Natural Remedies*, *13*(2), 133-137.
42. Ndamitso, M. M., Mohammed, A., Jimoh, T. O., Idris, S., Oyeleke, S. B., & Etsuyankpa, M. B. (2013). Phytochemical and antibacterial activity of Securidaca longepedunculata on selected pathogens. *African journal of microbiology research*, *7*(50), 5652-5656.
43. Okomolo, F. C. L., Mbafor, J. T., Bum, E. N., Kouemou, N., Kandeda, A. K., Talla, E., ... & Rakotonirira, E. V. (2011). Evaluation of the sedative and anticonvulsant properties of three Cameroonian plants. *African Journal of Traditional, Complementary and Alternative Medicines*, *8*: 181-190.
44. Oladunmoye, M. K., & Kehinde, F. Y. (2011). Ethnobotanical survey of medicinal plants used in treating viral infections among Yoruba tribe of South Western Nigeria. *African Journal of Microbiology Research*, *5*(19), 2991-3004.
45. Olofintoye, K. (2019). Comparative evaluation of Molluscicidal effects of Securidaca longepedunculata (Fres.) and Tephrosia bracteolate (Guilland Perr) on Bulinus globosus. *J. Parasitol. Vector Biol.*, 2: 44-47.
46. Oni, P. I., Jimoh, S. O., & Adebisi, L. A. (2014). Management of indigenous medicinal plants in Nigeria using phenological information. *J. Med. Plants Res.*, *8*: 619-631.
47. Tabuti, J. R., Kukunda, C. B., Kaweesi, D., & Kasilo, O. M. (2012). Herbal medicine use in the districts of Nakapiripirit, Pallisa, Kanungu, and Mukono in Uganda. *Journal of ethnobiology and ethnomedicine*, *8*(1), 35.
48. Tshisikhawe, M. P., Van Rooyen, M. W., & Bhat, R. B. (2012). An evaluation of the extent and threat of bark harvesting of medicinal plant species in the Venda Region, Limpopo Province, South Africa. *Phyton-Int J Exp Bot, 81*: 89-100.
49. Van Wyk, B. E., & Gericke, N. (2000). *People's plants: a guide to useful plants of Southern Africa*. Briza Publications.
50. Van Wyk, B. E., Van Oudtshoorn, B. and Gericke, N. (2005). *Medicinal Plants of South Africa*, 1st Edition, Briza Publications, Pretoria, P. 236.
51. Van Wyk, B. E., Van Oudtshoorn, B. and Gericke, N. (2009). *Medicinal Plants of South Africa*, 2nd Edition, Briza Publications, Pretoria, P. 268.
52. Viol, D. I. (2009). *Screening of Traditional Medicinal Plants from Zimbabwe for Phytochemistry, Antioxidant, Antimicrobial, Antiviral and Toxicological Activities*. Master of Philosophy Dissertation. University of Zimbabwe, Zimbabwe.