Poisonous snake envenomation is a complex neglected health problem implicated in mortality, disability, psychological morbidity, and socio-economic losses recorded worldwide. An antivenin serum, the only medically recommended treatment for snakebites, has several drawbacks including, hypersensitivity, inability to prevent local tissue damage, are scarce and unaffordable in most snakebite endemic areas. In many rural communities all over the world, plants have been utilized for managing snakebites. This review seeks to identify plants reported as antivenom remedies in the East Africa and the scientific studies thereof which could support their use in the treatment of snake envenomation. A review of scientific articles was undertaken to identify information on traditional knowledge of medicinal plants used to treat snake envenomation in East Africa and their antivenom efficacy. A total of 361 plant species were retrieved to have been reported as traditional therapies for snakebites in East Africa. The review identified distinct cases of doctrine of signatures and zoopharmacognosy in snakes using Opilia amentacea, Hugonia castaneifolia and Microglossa pyrifolia respectively. Evaluations of the antivenom efficacy of 44 species (12.2%) have been done globally, and most species found to be effective in neutralizing the lethal activities of snake venoms. Ethnomedicinal plants play a revered holistic role in East African antisnake venom therapy. Conyza sumatrensis, Hyptis pectinata, Justicia betonica, and Maesa lanceolata used to treat specific snakebites merit further studies.
**Introduction**

Envenomation by poisonous snakes is a complex neglected health problem implicated as one of the major causes of mortality, disability, psychological morbidity, and socio-economic losses recorded worldwide [1]. About 2.7 million people are bitten by snakes annually and 81,000-138,000 of these victims die [2]. An additional 400,000 amputations and other severe health consequences such as psychological sequelae, haemorrhage, tetanus, contractures, myonecrosis, scarring, and tissue inflammation accompany the bites [3, 4]. Snake envenomation was added to the list of the neglected tropical diseases by the World Health Organization (WHO) in March 2009 and later removed [5]. With sufficient epidemiological data, the menace was re-included in category A of neglected tropical diseases in June 2017 [6]. In East Africa, there are at least 200 species of snakes reported [7]. Some are harmless or rare; however, the puff adder (*Bitis arietans*), Gabon viper (*Bitis gabonica*), green or Jameson's mamba (*Dendroaspis jamesoni*), black mamba (*Dendroaspis polylepis*), forest cobra (*Naja melanoleuca*) and black-necked spitting cobra (*Naja naja nigricollis*) accounts for most venomous bites in the East African Community [7-10].

Horse-derived antivenin sera is currently the mainstay for neutralization of the systemic actions of snake venoms. However, they are ineffective in the neutralization of local tissue damage which continues even after intravenous administration of the antidote [11]. Worse still, they exert no effect on the reversal of local symptoms, are unavailable, possess administration problems and usually induce adverse reactions such as progeny reaction, anaphylactic shock, and serum sickness [12]. The barriers to effective management of snake envenomation in East African Community ranges from poor road networks, fragmented records and lack of public health education to the absence of antivenoms and poor antivenom preservation facilities in health centres [8, 10, 13-15].

This context has been the force behind the obsessive search for complementary treatments for snakebites [7, 11, 16]. Therefore, the use of plants and other traditional alternatives in rural areas for managing the scourge of snakebites is justifiable. WHO reported that 80% of the emerging world's population subsists on traditional medicine for various ailments. Similarly, the developed countries have also portrayed ascendancy in the use of complementary and alternative medicine, particularly employing herbs [17, 18]. It is not surprising therefore that most allopathic medications have their roots from ancient medicine, and it is argued that novel therapeutic molecules will be developed from African biodiversity in close association with leads furnished by traditional knowledge and experiences [19, 20]. The revered utilization of medicinal plants in rural Africa, and specifically East Africa is linked to cultural and economic reasons. This is why WHO encourages African member states to promote and integrate traditional medical practices in their health systems. In the current study, we reviewed literature on the knowledge and practices of snakebite management in Eastern Africa using medicinal plants. A probe was made into antivenom studies to discern if the use of the identified species in antivenom therapy is justifiable.

**Methods**

We used the definition of East Africa as the region including Uganda, Kenya, Tanzania, Rwanda, Burundi, and South Sudan. An electronic review of the literature was perfected in two steps: firstly, we searched all the published work (ethnobotanical books, reviews, reports, theses and primary scientific articles) with data on medicinal plants related to the six countries. The search key terms: snakebite, snake envenomation, snake poison, traditional medicine, ethnobotany, alternative medicine, ethnopharmacology, antivenom, antivenin, antiophidic, antitoxin, and snake antidotes were combined with the individual names of the
countries [7, 104]. Secondly, a search targeted to the use of medicinal plants in antivenom therapy was done. We extracted information on the knowledge and practices of treating snakebites using medicinal plants in the region. The review also examined the supportive evidences from global studies for the efficacy of the identified plant species to discern if their use in antivenom therapy is justified. Databases: Scopus, Science Direct, PubMed, Web of Science Core Collection, Scientific Electronic Library Online, Google Scholar and the Google search engine were used to source for scientific information dated until August 2020. Only full text primary research articles published in peer-reviewed journals, books, theses, dissertations, patents and reports written or translated to English were considered. Missing information in some studies such as local names, plant growth forms, and misspelled botanical names were checked from google search engine and botanical databases: The Plant List, International Plant Names Index, NCBI taxonomy browser and Tropicos. The majority of the plant names were checked manually in the botanical databases at point of entry, while the remainder were already previously checked as part of our previous work on medicinal plants in the region [7, 8, 104, 114, 177]. The collected data were checked for completeness and processed independently by the authors. Descriptive statistical methods were used to analyze the collected data. Results on ethnomedical plants used in treating snake poisoning in East Africa.

### Ethnomedicinal plants used in treating snake poisoning across East African countries

This review retrieved 361 plant species used in treating snake poisoning in different parts of East Africa. The identified species belong to 240 genera spread across 82 botanical families (Table 1). A whole fungus (Termitomyces mirocarpus, locally known as Akatiko akabaala in Luganda dialect) is also eaten in Uganda for management of snakebites [21]. The common botanical families of the identified plants were Fabaceae (53 species, 14.8%), Asteraceae (25 species, 7.0%), Apocynaceae and Euphorbiaceae (16 species, 4.5%), and Rubiaceae (15 species, 4.2%) (Figure 1). Fabaceae dominates in ethnobotanical surveys owing to the universal prevalence of species from this family as well as the possession of pathways that produce flavonoids, terpenoids, and alkaloids which are key therapeutic secondary metabolites [22].

| Plant family     | Botanical name                           | Local name(s)                  | Part(s) | Habit       | Mode of preparation/administration | Country         | Authors |
|------------------|------------------------------------------|--------------------------------|---------|-------------|-----------------------------------|-----------------|---------|
| Acanthaceae      | Asystasia gangetica T. Andr.             | Kichwangwo (Swahili)           | L       | Herb        | Not reported                      | Tanzania        | [23]    |
|                  | Asystasia schimperi T. Anders.           | Nyante (Lusoga)                | Rt      | Herb        | Chewed                            | Uganda          | [24]    |
|                  | Barleria grandicalyx Lindau              | Cheberenet (Kipsigis)          | L       | Shrub       | Chewed/pulped and rubbed on the bite | Kenya           | [25-27] |
|                  | Dyschoriste hildebrandii                 | Kwilangaswe (Shambas)          | Rt      | Shrub       | Decoction drunk/ used for washing bite | Tanzania        | [26]    |
|                  | Echolium viride (Forssk.) Alston         | Mbuguno (Sakuma)               | Rt      | Shrub       | Chewed. For further treatment, infusion taken/used for washing the wound | Tanzania        | [26, 28] |
|                  | Justicia betonica                       | Muzukizi (Luganda), L (green)  | Herb    | Infusion drunk |                                    | Uganda          | [26, 29] |
| Plant family       | Botanical name | Local name (s) | Part (s) | Habit | Mode of preparation /administration | Country | Authors |
|-------------------|----------------|----------------|----------|-------|-------------------------------------|---------|---------|
| **L.**            | Cheborenet-Neo (Kipsigis), Liumasawi (Luhya) | cobra bites. Juice applied on the bite | Kenya     |       |                                     |         |
| **Justicea**      | calyculata    | Apiwo, Piu piu (Luo) | AP Herbal | Crushed and rubbed on the bite to facilitate removal of the "snake’s fangs" | Kenya [30, 31] |
| **Justicea**      | heterocarpa   | Mwidu (Kihuguru) | L Herbal  | Not reported | Tanzania [32] |
| **Pseuderranthem um** | hildebrandtii Lindau | Mguura (Shambaa) | Rt Shrub  | Not reported | Tanzania [26] |
| **Thanbergia**    | alata Bojer ex Sims | Nyakatayo (Jita, Kerewe) | L Herbal  | Fresh powder mixed with water to give paste applied on incisions of affected area | Tanzania [33] |
| **Whitfieldia**   | elongate      | Ngeula (N guru) | Rt Shrub  | Chewed | Tanzania [26] |
| **Achyranthae**   | aspera L.     | Kagiri (Luganda) | Rt, Sd Herbal | Apply paste on bitten part | Uganda, Tanzania [21, 34] |
| **Aerva**         | lanata (L.) Juss. ex Schult. | Luwecha (Sinkuma), Paramoya (Shambaa) | Rt Herbal  | Not reported | Tanzania [26] |
| **Aerva**         | leucura       | Mwenza (Bende) | Rt Herbal  | Not reported | Tanzania [26] |
| **Cytathla**      | uncinulata    | Kulabakak (Karamojong) | Rt Herbal  | Apply powder to bite area after making small cuts with a razor blade | Uganda [35] |
| **Psilotrichum**  | elliotii Baker | Nyangarakilo (Ngoni) | Rt, Herbal | Chewed | Tanzania [26] |
| **Pupalia**       | lappacea (Linn.) juss | Mamata (Shambaa) | Rt Herbal  | Infusion drunk thrice a day | Tanzania [26] |
| **Amaranthaceae** | **Allium**     | cepa L. | Kitunguu (Kamba), Tungulu (Luo) | L, Rt, Bb Herb | Pounded and sap applied. Squeeze, mix with ash, put on the affected area | Uganda, Kenya [21, 24, 30, 35-39] |
| **Amaryllidaceae**| **Allium**     | sativum L. | Katungulacumu (Lug) | Bb Herb | Crush, smear at the bite. | Uganda [37] |
| **Amocharis**     | tinneana      | Joda (Luo of Uganda), Apap (chwee pap), Rabwondo (Luo) | L, Rt Herbal | Decoction drunk. Sap used in preparation of an alespheric | Uganda, Kenya [30, 31, 35] |
| **Crinum**        | kirkii Bak    | Atungulu (Lango) | Bb Shrub  | Not reported | Uganda [36] |
| **Haemanthus**    | multiflorus   | Soota (Lusoga) | Tuber, Rt | Herb | Decoction taken | Uganda [24, 40] |
| **Anacardiaceae** | **Lannea**     | kirkii Burtt Davy. | Mtundu (Suaheli) | Rt Tree | Not reported | Tanzania [23] |
| **Lannea**        | schweinfurthii Engl. | Kyusi, Muasi | L Tree | Terminal leaves infusion drunk | Kenya [39] |
| **Lannea**        |welwitschii (Hiern) Engl. | Mukowa (Luganda) | Bk Tree | Used with another unspecified tree | Uganda [26] |
| **Heeria**        | mucronata Bernh. | Mkalakala (Nyamwezi) | L Tree | Juice used as antidote | Tanzania [23] |
| **Ozoroa**        | insignis Delile | Mutung’wa (Markwet) | B Tree | Crushed and extract applied on the bite | Kenya [41] |
| **Ozoroa**        | mucronata (Bernh. Ex Krauss) R&A.Fernandes | Liviangi (Matengo), Mlago (Nyamwezi, Sinkuma) | L Tree | Juice used as antidote | Tanzania [26, 28] |
| **Searsia**       | pyroides      | Akakwansokwanso | L, Rt Shrub | Immediately eat the | Uganda [21] |
| Plant family | Botanical name | Local name (s) | Part(s) | Habit | Mode of preparation /administration | Country | Authors |
|-------------|----------------|----------------|--------|-------|------------------------------------|---------|---------|
| Apocynaceae | *Annona* chrysoylla Bojer. | Obolo (Lao), Mtetepoete, Mfira, Mkonora (Nyamwezi) | Rt, L | Shrub | Decoction drunk | Uganda, Tanzania | [23, 35] |
|             | *Annona* senegalensis Pers. | Obolo, obolobolo (Luo), Likonyo (Ita) | L, St, Rt, SB | Tree | Crushed and rubbed on bite. Chewed & juice swallowed. Stem and leaf decoction taken. Rt poultice applied topically | Uganda, Kenya, Tanzania | [30, 31, 33-35, 42] |
| Apioaceae   | *Popowia* fornicata Baill. | Mkaila (Nyamwezi) | Rt, L | Shrub | Powdered and used | Tanzania | [23, 34] |
|             | *Uvaria* acuminata Oliv. | Msfofu (Swahili) | Rt | Shrub | Decoction taken | Tanzania | [26, 28, 43] |
|             | *Uvaria* schefferi Diels | Mukumuka (Kamba) | Rt, L | Shrub | Dried in the sun and powder applied | Kenya | [30] |
|             | *Ovariodendron* anisatum Verdc. | Ndongo (Embub, Kamba) | Rt, WP, L | Shrub | Ashes applied to the bite | Kenya | [44-47] |
| Apioaceae   | *Coriandrum* sativum L. | Gilgilani (Swahili), dhaninya (Laganda) | NS | Herb | Infusion with raw eggs and little lemon taken | Uganda | [29] |
|             | *Heterorompha* trifoliata Wendl Eckl & Zeyh. | Laguguni (Zigua) | L | Tree | Not reported | Tanzania | [26] |
| Apioaceae   | *Steganotenia* aralacea Hochest. | Muuvuui, Kivuuui (Kamba), Chokudo (Pokot), Mogura (Zigua), Ovihiro (Acholi), Ijihwi (Lango) | Rt, L | Shrub | Rt burnt & powder applied topically. Chewed. Leaf infusion used to wash out venom from eyes to avert blindness | Uganda, Kenya, Tanzania | [26, 30, 35, 36, 39, 48] |
| Apioaceae   | *Acokanthera* schimperi (A.D.C) Schwein | Kehwo/Ng'wono (Marakwet) | Bk | Tree | Powder applied on incisions made on the bitten area to arrest venom movement | Kenya | [49] |
|             | *Alstonia* boonei De Wild | Mujwa (Lunyoro), Mukoge (Laganda) | Rt, St | Tree | Infusion drunk | Uganda | [26] |
| Apioaceae   | *Ancylobathrys* petersiana (Klotzsch) Pierre | Kabaneza (Sandawi) | Rt | Shrub | Decoction taken | Tanzania | [26] |
| Apioaceae   | *Calotropis* procera (Aiton) W.T.Aiton | Boah (Somali), Ettihuru (Turkana), Mjamba Mewtu (Swahili) | Rt | Shrub | Not reported | Tanzania | [26, 50] |
|             | *Carissa edulis* (Forsk.) Vahl | Ekamuriel (Ateso) | Rt | Shrub | Not reported | Uganda | [51] |
| Apioaceae   | *Carissa* spinarum L. | Mukawa (Kamba) | L | Shrub | Not reported | Kenya | [52] |
| Apioaceae   | *Catharanthus* roseus (L.) G.Don | Olubinu | L | Herb | Infusion drunk | Kenya | [26] |
| Apioaceae   | *Ceropegia* lagardiae Schltr. | Gonyera (Sukuma) | Fresh Rt | Tree | Chewed & juice swallowed. The rest of chewed stuff is squeezed on the wound | Tanzania | [26, 28, 50] |
| Apioaceae   | *Cryptolepis sanguinolenta* (Lindl) Schltr | Kafulu/muganga kiba (Lusoga) | Rt | CL | Chewed, rubbed at the bite | Uganda | [24] |
| Apioaceae   | *Diplorhynchus* condylocarbon | Mjogo (Rufiji), Msonga (Nyamwezi) | Rt, Bk, AP | Shrub | Used as powder | Tanzania | [26, 28, 34] |
| Apioaceae   | *Diplorhynchus* mossambicensis Benth. | Mjogo (Segula), Mbelembele (Nyamwezi) | RB | Shrub | Not reported | Tanzania | [23] |
| Apioaceae   | *Dregea* abyssinica (Hochst.) K. Schum. | Lamee, Ubombo (Shambaa) | Fresh Rt | Tree | Chewed | Tanzania | [26] |
| Plant family | Botanical name | Local name (s) | Part(s) | Habit | Mode of preparation /administration | Country | Authors |
|--------------|----------------|----------------|--------|-------|-------------------------------------|---------|---------|
| **Landolphia** | *Landolphia petersiana* (Klotzsch) Dyer. | Mbohoya (Nyamwezi), Mpera ya porini (Swahili) | Twigs, Fr | CL | Not reported | Tanzania | [23] |
| **Secamone** | *Secamone parvifolia* (Oliv.) Bullock. | Limuaga (Sukuma), Meramera (Nyamwezi) | Rt | Shrub | Decoction taken | Tanzania | [26, 28, 50] |
| **Strophanthus** | *Strophanthus emissii* Asch. ex Pax | Msengululu (Nyamwezi), Msangururu (Sukuma) | Br, Rt, Sd | Liana | Chewed. Pounded Rt soaked in warm water and vapour inhaled while bathing | Tanzania | [26, 28, 50] |
| **Thevetia** | *Thevetia peruviana* (Pers.) Schumann | Busitani (Lusoga) | Rt | Shrub | Infusion drunk | Uganda | [24] |
| **Aristolochiaceae** | *Aristolochia densivenio* Engl. | Lunkulwe (Shambaa, Sukuma) | Rt | Herb | Not reported | Tanzania | [23] |
| **Aristolochia elegans** | *Aristolochia elegans* Mast | Mukumya (Luganda) | Rt | Liana | Infusion drunk, root chewed | Uganda | [24] |
| **Aristolochia petersiana** | *Aristolochia petersiana* Klotzsch | Lunkulwe, Unkulwe (Sukuma), Tamba Ya Nyoka (Swahili) | Rt | Herb | Pounded and mixed with salt | Tanzania | [26, 28, 50] |
| **Aristolochia coccata** | *Aristolochia coccata* Wall. | Kasero (Luganda) | Rt | CL | Decoction drunk | Uganda | [21] |
| **Aristolochia tomentosa** | *Aristolochia tomentosa* Sims. | Kankapu (Ateso) | St, Tree | Infusion drunk | Uganda | [51] |
| **Albuca abyssinica** | *Albuca abyssinica* Jacq. | Amujej (Ateso) | Blb, L | Herb | Decoction drunk/applied topically | Uganda | [35] |
| **Asparagus flagellata** | *Asparagus flagellata* (Kunth.) Baker | Umm Mushbat | Rt | Herb | Decoction | South Sudan | [54] |
| **Chlorophytum** | *Chlorophytum species* 1 | Emutungulu, akwangan (Ateso) | Tuber | Herb | Pound and apply on the snake bitten area | Uganda | [35] |
| **Chlorophytum species** | *Chlorophytum species* 2 | Eryau (Ateso) | Tuber | Herb | Chew fresh roots | Uganda | [35] |
| **Drimia** | *Drimia maritima* (L.) Stern | Baroug/galb albarida | Blb | Herb | Juice rubbed on place of bite | South Sudan | [55] |
| **Sansevieria** | *Sansevieria dawei* Stapf | Yat-twol (Lango) | Rt | Shrub | Pounded root extract given as an emetic | Uganda | [56] |
| **Sansevieria kirkii** | *Sansevieria kirkii* Baker | Mukonge (Hehe) | L, Rt | Herb | Leaf sap applied on bite. Rt decoction taken | Tanzania | [26] |
| **Sansevieria parva** | *Sansevieria parva* N.E.Br. | Twoch bungu (Luo) | L | Herb | Sap applied on the bite wound | Kenya | [30, 31] |
| **Sansevieria trifasciata** | *Sansevieria trifasciata* Prain | Tworo (Luo), Akagoooga (Luganda) | L, Rt | Herb | Pounded and drink juice. Applied topically. Rt crushed & chewed or chewed directly | Uganda | [35, 56] |
| **Aspilia africana** | *Aspilia africana* C.D. Adams | Makaayi (Luganda) | L, Rt | Herb | Squeeze and drink the juice 1 glass/day | Uganda | [21, 57] |
| **Aspilia pluriseta** | *Aspilia pluriseta* Schweinf. | Muti | L | Herb | Sap squeezed and applied | Kenya | [58] |
| **Bidens pilosa L.** | *Bidens pilosa* L. | Nyanyiek mon, Onyiego (Luo), Sere/labika (Luganda) | L, WP | Herb | Crushed & rubbed on fresh cuts as an astringent, bite antidote and antiseptic | Uganda, Kenya | [24, 30, 31] |
| **Blepharispermum zunguebaricum** | *Blepharispermum zunguebaricum* Oliv. & Hiern | Mkonaka (Sukuma) | Rt | Shrub | Chewed boiled or pounded and soaked in water. | Tanzania | [26] |
| **Bothriocline longipes** | *Bothriocline longipes* (Oliv. & Hiern) N.E.Br. | Ekyoganyanja | L | Herb | Make incisions on snake bite and apply | Uganda | [38] |
| **Conyza canadensis L. Cronq.** | *Conyza canadensis* L. Cronq. | Akamwiesanga (Kerewe) | WP | Herb | Decoction taken | Tanzania | [33] |
| **Conyza persicifolia** | *Conyza persicifolia* | Not reported | L | Herb | Not reported | Kenya | [26] |
| Plant family       | Botanical name                                      | Local name(s) | Part(s) | Habit                      | Mode of preparation /administration                      | Country | Authors |
|-------------------|----------------------------------------------------|---------------|---------|----------------------------|---------------------------------------------------------|---------|---------|
| (Benth.) Oliv. &  | Conyza sumatrensis (Retz.) E. Walker              | Yadh asere,  | L.      | Herb                       | Infusion drunk for puff adder bites                     | Kenya   | [30, 31]|
| Hier.             |                                                    | yadh tong (Luo) |         |                            |                                                         |         |         |
|                   | Crassecephalum manni (Hook.f.) Milne-Redh.         | Mgangogango   | L (fresh)| Shrub                      | Decoction (500 ml) drunk                                | Uganda, | [33, 59]|
|                   |                                                    | (Korewe, Ekigango |         |                            |                                                         | Tanzania|         |
|                   | Echinops ampeliscaulis Oliv.                       | Lukwango (Luo) | Rt      | Herb                       | Infusion drunk once/chewed and applied on site the next day | Uganda  | [35, 57]|
|                   |                                                    |               |         |                            |                                                         |         |         |
|                   | Echinops isspaeocyphal L.                          | Okeya (Luo)   | Rt      | Herb                       | Infusion drunk once/chewed and applied on site the next day | Uganda  | [35]    |
|                   | Echinops longifolius A. Rich.                     | Ofililii (Karamojong), okeya (Luo) | L | Herb | Burnt into ashes and applied topically once only/rubbed directly on bitten part/mix 1 teaspoon with water | Uganda  | [35]    |
|                   | Erigeron floribundus (Kunth) Sch.Bip.             | Ejut dokei (Ateso) | L | Herb | Squeezed juice drunk thrice a day for at least 3 days | Uganda  | [35]    |
|                   |                                                    |               |         |                            |                                                         |         |         |
|                   | Lactuca inermis Forssk.                            | Ekle (Ateso)  | Rt      | Herb                       | Infusion drunk thrice a day for 3 days                  | Uganda  | [35]    |
|                   | Microglossa pyrifolia (Lam.) O. Kuntze             | Etutum (Ateso), Akaajagakade (Uganda) | Rt | Herb | Decoction drunk for 2 days/Cheated. Poullice used | Uganda  | [21, 24, 35] |
|                   | Senecio bystrapartitus                             | Rwinkithia (Meru) | Rt | Tree | Powder applied topically and covered with leaves of C. molle. The wound is then bandaged using dry banana sheaths | Kenya | [26]    |
|                   | Sigesbeckia orientalis L.                          | Yat twol (Luo) | L | Herb | Squeezed juice drunk/paste applied topically | Uganda  | [35]    |
|                   | Solanecio manni (Hook.f) C. Jeffrey               | Maroo, marowo (Luo), Livokho, Yergekwa (Markwet) | L | Shrub | Crushed/chewed leaves rubbed onto the bite | Kenya | [26, 30, 31, 41] |
|                   |                                                    |               |         |                            |                                                         |         |         |
|                   | Tagetes minuta L.                                 | Muvangi (Kamba) | L | Herb | Infusion applied on the bite | Kenya | [30]    |
|                   |                                                    |               |         |                            |                                                         |         |         |
|                   | Tithonia diversifolia (Hems.f.) A. Gray.          | Maua madongo, akech (Luo), Mula (Kamba) | L | Shrub | Infusion administered orally | Kenya | [30, 31]|
|                   |                                                    |               |         |                            |                                                         |         |         |
|                   | Vernonias amgodalina Del.                         | Mtugutu (Zigua) | L | Tree | Chewed | Tanzania | [60] |
|                   | Vernonias auricilfera Hier.                       | Lisavakhwa    | L | Herb | Crushed and applied topically | Kenya | [61]    |
|                   | Vernonias biafrae Oliv. & Hier.                   | Ebwoibwol (Ateso) | Rt | Herb | Pound and mix with water and drink as a purgative | Uganda | [35]    |
|                   | Vernonias cinerea (L) Less                         | Yat Kwong (Lango), Lukohe (Luganda), Kifuba (Swahili) | WP, L | Herb | Leaves chewed or infusion drunk | Uganda, Kenya | [24, 26, 36] |
|                   |                                                    |               |         |                            |                                                         |         |         |
|                   | Vernonias glabra (Steez) Vatke                    | Olusia (Luo)  | L | Herb | Ashed/ crushed & rubbed on the bite | Kenya | [30, 31]|
|                   | Balanophoracaeae                                  | Ibatikanthi (Mbeere) | NS | Herb | Not reported | Kenya | [46]    |
|                   | Basellaceae                                       | Enderrema (Luganda) | WP | CL | Crushed & packed on the bite | Uganda | [62]    |
|                   | Bignoniaceae                                      | Markhamia lutea (Benth.) K. schum | L | Tree | Fresh leaf infusion drunk and used for cleaning the bite | Kenya | [26]    |
| Plant family       | Botanical name                      | Local name(s)                          | Part(s) | Habit                      | Mode of preparation/administration | Country       | Authors |
|-------------------|-------------------------------------|----------------------------------------|---------|----------------------------|-----------------------------------|---------------|---------|
| **Combretaceae**  | *Markhamia obtusifolia*             | Mkala (Haya), Mpapa (Zinza), Mgupsugupsu (Zaramo) | Rt, L   | Tree                       | Root decoction taken              | Tanzania      | [24, 50, 63, 64] |
|                   | *Trichodesma zeylanicum* (L.) (Burm.f.) R.Br. | Agilo (Lango), Igunguru (Nyamwezi)    | Rt, L   | Tree                       | Chewed, or pounded and decoction drunk while some are used for washing the wound. Leaf powder used | Uganda, Kenya, Tanzania | [26, 28, 36, 41, 65] |
|                   | *Combophora africana* (A. Rich.) Endl | Osilalei (Maa), Mutungu (Kamba), Mhambara, Mpororo (Swahili), Mpome (Rufiji) | Bk      | Tree                       | Chewed alone and swallowed or with *Nicotiana tabacum* and applied on bite. Washed bark with salt applied on bite | Kenya, Tanzania | [26, 34, 66] |
| **Burseraceae**   | *Bursera pilosa* Eng.               | Mponda (Nyamwesi)                      | Rt, L   | Tree                       | Not reported                      | Tanzania      | [23]    |
|                   | *Bursera eminii* Eng.               | Müküngügü (Kikuyu)                    | Bk, St, Rt | Tree                      | Decoction, root powder used      | Kenya, Tanzania | [41, 63, 67] |
|                   | *Bursera species*                   | Munumono, Muongo (Nyamwezi)           | Bk      | Tree                       | Not reported                      | Tanzania      | [22]    |
|                   | *Bursera zimmermannii*              | Mbombwe (Shambaa), Mnyalwa (Swahili), Mtilansuwi (Sukuma) | Rt      | Tree                       | Not reported                      | Tanzania      | [26]    |
| **Cannellaceae**  | *Warburgia ugandensis* Sprague      | Ntale ya dindungu (Uganda), Eusuk (Ateo) | L, Bk   | Tree                       | Fresh leaf or dried bark decoction drunk 1 tea spoonful thrice daily | Uganda        | [38]    |
| **Capparaceae**   | *Maerua kirkii* (Oliv.) F.White     | Moramana (Nyamwesi)                    | Rt      | Shrub                      | Decoction taken                  | Tanzania      | [28]    |
|                   | *Maerua triphylla* A. Rich.         | Chokowa (Fokot), Milamila (Ziga)      | Fresh Rt | Tree                      | Chewed, infusion drunk/used for washing the wound | Tanzania      | [26, 68] |
|                   | *Thylachium africanum* Lour.        | Nguruka (Sukuma)                      | Rt      | Shrub                      | Not reported                      | Tanzania      | [26]    |
| **Capparidaceae** | *Capparis micrantha* A. Rich.       | ElMardo                                | Rt      | Shrub                      | Decoction                        | South Sudan   | [54]    |
|                   | *Capparis tomentosa* Lam.           | Muzingani (Lusoga)                    | Rt      | Shrub                      | Infusion drunk                   | Uganda        | [24]    |
| **Caricaceae**    | *Carica papaya* L.                  | Apapal (Lango), Paapali essajja (Laganda) | Rt      | Tree                       | Chew, poulitice applied to the bite | Uganda        | [24, 36, 51] |
| **Celastraceae**  | *Maytenus senegalensis* (Lam) Exeill. | Eterka, Itereka (Lango), Luvenje (Sukuma) | Rt, L   | Tree                       | Leaves crushed and soaked in water are used to prepare an eye-drop | Uganda, Tanzania | [26, 28, 36] |
|                   | *Gymnosporia* species               | Mibwasungu (Nyamwesi)                 | Bk      | Tree                       | Not reported                      | Tanzania      | [23]    |
| **Cleomeaceae**   | *Cleome gynandra* L.                | Akeo (Lango), Eyobyo (Rutoro)         | Fresh L | Herb                      | Infusion drunk                   | Uganda        | [59]    |
| **Colchicaceae**  | *Gloriosa superba* L.               | Lobon bong (Karimojong), Emmreynamamunyie (Uganda) | Rt      | Herb                      | Powder sometimes mixed with those of *G. daleni*. Paste applied on the bite | Uganda        | [21, 35] |
| **Combretaceae**  | *Combretum aculeatum* Vent.         | Shikheit                               | Rt      | Shrub                      | Decoction                        | South Sudan   | [54]    |
|                   | *Combretum apiculatum* Sond.        | Landala (Sukuma), Musana (Nyamwezi), Leleiya (Markwet) | Rt      | Tree                       | Chewed or may be pounded, soaked in water and the infusion/decoction drunk | Tanzania, Kenya | [26, 28, 41] |
|                   | *Combretum collinum* Fresen         | Adugo (Lango), Odugu (Lango, Acholi), Ititu (Kamba) | Rt      | Tree                       | For treatments effected by scarification | Kenya, Uganda | [26, 30, 31, 36, 48] |
|                   | *Combretum constrictum*             | Mhambagoma (Shambaa)                  | Rt      | Tree                       | Chewed roots put on snake bite wounds | Tanzania      | [26]    |
| Plant family | Botanical name | Local name(s) | Part(s) | Habit | Mode of preparation /administration | Country | Authors |
|--------------|----------------|---------------|---------|-------|-----------------------------------|---------|---------|
| *Combretum* | gueinzii Sond. subsp. splendens Exell. | Mulama, Mlama (Nyamwezi), Mnama (Sukuma) | Rt, L | Tree | Not reported | Tanzania | [23] |
| *Combretum* | longispicatum (Engl.) Engl. & Diels | Linsugu (Nyamwezi) | Rt | Tree | Powder used | Tanzania | [28] |
| *Combretum* | microlepidotum | Msaau (Sawa) | Rt | Tree | Fresh or dry roots chewed | Tanzania | [26] |
| *Combretum* | molle G. Don | Muama, Kiama (Kamba), Loro (Lango), Mukhungula (Luhya) | Bk, Rt, L, RB | Tree | Infusion/decoction drunk 2 glasses twice a day. Leaves are placed on the wound on which has been applied *S. lyratipartitus* Rt powder & banana leaves are used as bandage. A mixture of small chips of Rt and Rt of *M. obtusifolia* and *Vungueria rotundata* is applied to the bite | Uganda, Kenya, Tanzania | [26, 30, 34, 36, 39, 41, 50, 61, 63, 64] |
| *Combretum* | padoides Engl. & Diels | Mshinda arume | L | Tree | Crushed leaves are applied on the bite | Kenya | [69] |
| Commelinaceae | *Aneilema petersii* (Hassk.) C.B.Clarke | Nganga Kuhula (Sukuma) | Rt | Herb | Chewed. Decoction drunk and some of it used for washing the wound | Tanzania | [26] |
| *Murdannia simplex* Vahl. Branan | Muhinduka (Rutoro) | Fresh L | Shrub | Squeeze and drink | Uganda | [59] |
| Connaraceae | *Byrsocarpus orientalis* (Baill.) Baker | Fili (Sukuma), Mpandaradu, Mungitungo (Ndengereko) | Rt | Shrub | Dried roots are burnt, mixed with powdered charcoal and tobacco, and the infusion drunk | Tanzania | [60] |
| *Astrypomoe amalvacea* (Klotzsch) A. Meeuse | Apom (Ateso) | Rt, St | Herb | Decoction drunk once daily for 2-5 days | Uganda | [35] |
| *Dichondra repens* J.R. Forst. & G. Forst. | Not reported | L | Herb | Rubbed on bite to “remove snake fangs” | Kenya | [30, 31] |
| *Hewittia malabarica* (L.) Suresh | Musotataluma (Uganda) | Rt, L | CL | Paste applied on the bite | Uganda | [21] |
| *Hewittia sublobata* L. Kuntze | Musota tallyum (Luganda) | Rt, tuber | Herb | Smeared on head and bitten part | Uganda | [37] |
| *Ipomoea batatas* (L.) Lam. | Icok (Lango), Mboli (Lusoga), Lumonde (Luganda) | Rt, tuber | Herb | Chewed | Uganda | [24] |
| *Jacquemontia paniculata* (Burm. f.) Hall. f. | Mwiliimbwi (Zigua) | Fresh Rt | Herb | Pounded and applied topically | Tanzania | [60] |
| *Jacquemontia tannifolia* (L.) Griseb. | Kikopwe (Swahili) | Rt, L | CL | Chewed/decoction drunk and used for washing the wound | Tanzania | [26] |
| *Merremia angustifolia* Hall. f. | Miguasungu (Nyamwezi) | L | Herb | Not reported | Tanzania | [23] |
| Crassulaceae | *Bryophyllum delagoense* (Eckl. & Zeyh.) | Omucaga (Ateso) | L | Herb | Leaf juice/paste taken orally | Uganda | [35] |
| Plant family | Botanical name | Local name (s) | Part(s) | Habit | Mode of preparation /administration | Country | Authors |
|-------------|----------------|---------------|---------|-------|--------------------------------------|---------|---------|
| Cucurbitaceae | Coccinia grandis (L.) Voigt | Bomo twol (Luo) | Rt, Herb | Decoction taken | Uganda | [35] |
| | Corallocarpus boehmi (Cogn.) C. Jeffrey | Nyercha (Sukuma) | Rt, Herb | Infusion drunk | Tanzania | [26] |
| | Curcubita maxima Duschesne | Marenge (Embu, Mbeere, Meru) | NS, Herb | Not reported | Kenya | [46] |
| | Cyperaceae | Cyperus rotundus L. | Omugugu | L, Herb | Decoction taken; residue smeared on affected area | Uganda | [38] |
| | Dilleniaceae | Euclea divinorum Hiern | Jeptuiya, Usweet (Markwet), Cheptuyaa (Pokot), Muda, Kavulagula | Bk, Rt, Tree | Crushed & applied on incisions made on bite area. Sometimes used with Gardenia volkensii and Plectranthus barbatus. Root decoction drunk | Kenya, Uganda | [24, 41, 70-72] |
| | Diospyros usambarensis F. White | Mkongo (Kamba), Mkuruponya (Giriama) | Fresh Rt, Shrub | Chewed or soaked in water and used orally, and externally for washing the wound | Tanzania | [26] |
| | Ebenaceae | Royena macrocalyx Gürke | Mdaa (Swahili), Mkuruponya (Giriama) | NS, Shrub | Not reported | Kenya | [53] |
| | Euphorbiaceae | Acalypha bipartita Muell. Arg. | Helele (Lusoga) | Rt, Herb | Poultice applied on the bite | Uganda | [24, 73] |
| | | Acalypha fruticosa Forrsk. | Mzahati (Nyamwezi) | L, Rt, Shrub | Not reported | Tanzania | [23, 34] |
| | | Croton macrostachyus Hochst. ex. Delile | Musogasoga (Lusoga) | Rt, tuber, Tree | Poultice smeared on the bite | Uganda | [37] |
| | | Cyathogyne bussei Pax | Kinkundunukesa (Zigua), Kiriihi, Maqishangwuu (Swahili) | Rt, Tree | Chewed and only the juice swallowed. Warm Rt decoction drunk. This prevent the poison from circulating in the blood | Tanzania | [26] |
| | Euphorbia candelabrum Trémaux ex Kotschyi | Enkuukuulu (Uganda) | Rt, Shrub | Eaten immediately/decoction drunk | Uganda | [21] |
| | Euphorbia grantii Oliv. | Muthiri (Meru), Ndulwa Nsongo, Mtulasongo (Nyamwezi) | St, Tree | Fresh milky sap applied to wounds/fresh cuts | Tanzania | [26, 28] |
| | Euphorbia hirta L. | Acakaacak (Luo), Kasadasada (Luganda), Mtiwaziwa (Swahili) | Bk, Rt, Herb | Decoction drunk or paste applied on the bite | Tanzania | [21, 34, 35] |
| | Euphorbia hypericifolia L. | Loje (Karamojong) | L, Herb | Pounded/squeezed juice applied on bite twice daily for 2 days | Uganda | [35] |
| | Euphorbia tirucalli L. | Kilajok (Luo), Enkon (Rutoro), Ngesa | Rt, fresh L, Herb | Drink decoction/sap applied topically | Tanzania | [26, 34, 35, 59] |
| Plant family | Botanical name | Local name(s) | Part(s) | Habit | Mode of preparation /administration | Country | Authors |
|--------------|---------------|---------------|---------|-------|-----------------------------------|---------|---------|
| Crotalaria    | Crotalaria curcas L | Omororot (Lango), Ekiroowa (Luganda), Mucariki (Embu) | Fr, fresh L | Shrub | Leaf latex applied topically | Uganda, Kenya | [24, 46] |
|              | Crotalaria nodalensis | Jibiga (Somali) | Fresh Rt | Shrub | Chewed & juice taken/applied topically | Kenya | [26] |
|              | Ricinus communis L | Ekisogosga (Rutoro), Mukakale (Lusoga), Libono | SB, Rt, L | Tree | Mix bark with black salt and chew. Infusion drunk. Root/leaf decoction taken/applied topically | Uganda, Kenya | [24, 59, 61] |
|              | Securinega virosa (Wild) Baill. | Ilakara (Lango), Mkwamba (Shambaa & Swahili) | Rt, Fr | Tree | Chewed | Uganda, Kenya, Tanzania | [26, 36] |
|              | Saturegada zanzibarensis Pax | Mkangala (Sukuma) | L, Rt | Shrub | Roots chewed or its juice is drunk twice a day | Tanzania | [26, 28, 74] |
|              | Tragia brevipes Pax | Kimekei ne mining (Markweta) | Rt | Shrub | Crushed and applied on incisions on the bitten area | Kenya | [70, 72] |
|              | Tragia furialis Bojer | Kiwari (Swahili), Pupu (Zgwa) | WP, Rt | Tree | WP decoction drunk, Rt powder applied topically | Tanzania | [75] |
|              | Abrus precatorius L | Motipipiti (Swahili), Mwanga-La-Nyuki (Digo) | Rt, L | Cl | Chewed | Kenya, Tanzania | [23, 26] |
| Fabaceae     | Acacia brevispica Harms | Kiptare (Marakwet) | Rt | Tree | Decoction taken | Kenya | [26] |
|              | Acacia erifora (Forsk.) Schweinf | Laoat | Fresh Rt | Shrub | Crushed & rubbed on the bite; decoction taken | South Sudan | [55, 76] |
|              | Acacia polyantha Wild. | Mngowe (Padhola) | Rt | Tree | Chewed/infusion drunk/put on the bite | Uganda | [26, 34] |
|              | Acacia seyal Del. var. fistula (Schweinf.) Oliv. | Mufuhanduzi/Mwuela manyo (Lusoga) | Rt | Tree | Not reported | Uganda | [24] |
|              | Acacia species | Mukongoito (Lusoga) | Rt | Tree | Infusion drunk | Uganda | [24] |
|              | Aeschlea quanzensis | Mkongo (Swahili) | Fresh Rt | Tree | Chewed or infusion drunk | Tanzania | [26, 63] |
|              | Albizia corderia (Welw. ex) Oliver | Etek (Lango), Musita (Luganda, Lusoga) | Rt | Tree | Infusion drunk | Uganda | [24] |
|              | Albizia harveyi E.Fourn. | Mfiritziga | L | Tree | Not reported | Tanzania | [74] |
|              | Cajanus cajan (L.) Millsp | Ekolimbo/empindi (Luganda), Njugu (Embu) | Rt, L | Shrub | Squeeze and drink the juice | Uganda, Kenya | [21, 46] |
|              | Canavalia ensiformis L. D.C. | Yat twol (Luo), Kijanjalo (Luganda), Ekhibimba | Sd, L | Herb | Split & attach a clean piece on the affected area. Chew Sd. Leaf infusion drunk | Uganda | [35, 38, 40] |
|              | Cassia abbreviata Oliv. | Mahamba, Mhumba (Zgwa) | Rt | Tree | Decoction taken | Tanzania | [43] |
|              | Cassia occidentalis L. | Omwitanjoka (Rutoro) | Fresh L | Shrub | Decoction drunk; 500 ml thrice a day | Uganda | [59] |
|              | Cassia sieberana D.C. | Umm Kasho | Rt | Tree | Decoction taken | South Sudan | [54] |
|              | Cassia singueana Del. | Mvumba | L | Shrub | Juice taken | Tanzania | [64] |
|              | Crotalaria laburnifolia | Muongozo (Shambaa) | L | Herb | Pounded and applied to the afflicted area | Tanzania | [26] |
|              | Crotalaria | Sukuru Matvi | Fresh Rt | Herb | Chewed. Infusion is | Tanzania | [26] |
| Plant family | Botanical name | Local name(s) | Part(s) | Habit | Mode of preparation /administration | Country | Authors |
|--------------|---------------|---------------|---------|-------|----------------------------------|---------|---------|
| Dalbergia  | Dalbergia melanosylon | Genbe (Sukuma), Mpingo (Swahili, Zigua) | SB | Tree | Decoction drunk | Tanzania | [77] |
| Delonix  | Delonix elata | Mvetumubula (Nyanwesi), Mkeragembe | BK, RT, L, Fr | Tree | Rt or L chewed & paste applied on the bite to remove poison. Rt decoction drunk. Incisions are made at the site of bite and poultice from pods applied on snakebites | Tanzania, Kenya | [26, 53, 63, 77, 78] |
| Dichrostachys | Dichrostachys cinerea L. | Impangala (Nyika), Mjegere (Hehe), Mundua (Kamba), Mulagembe (Shamba), Msingino (Boni) | L | Tree | Not reported | Tanzania | [23] |
| Dichrostachys | Dichrostachys glomerata Chiov. | Mwingano (Chagga), Mtundulu (Nyanwesi), Mkeragembe | St, RT, MP, exudate | Tree | Stem crushed, sap squeezed out and applied on the bite. Root infusion taken | Kenya, Uganda | [30, 39, 79, 80] |
| Erythrina  | Erythrina abyssinica ex D.C. | Omutembe (Kuria), Muhuti (Kikuuyu), Ejrikiti (Luganda) | BK, RT | Tree | Sap is used as an antidote. Paste applied on the bite/decoction taken | Kenya, Uganda | [21, 26, 48, 81] |
| Erythrina  | Erythrina excelsa Baker | Roko, yuuma (Luo - Kenya), Omubajjangabo (Luganda) | BK | Tree | Sap is used as an antidote, squeeze and take juice or apply paste on the bite | Kenya, Uganda | [21, 30, 31] |
| Erythrophloeum | Erythrophloeum guineense Don. | Muhai (Songea), Mkola (Nyanwesi), Muaafi (Swaheli) | L | Tree | Not reported | Tanzania | [23] |
| Glycine  | Glycine max (L.) Merr. | Soya (Luo) | SD | Herb | Chewed | Uganda | [21, 35] |
| Indigofera  | Indigofera arrecta Host. A. Rich. | Erargwii (Lango), Kyeyo (Lusoga), Umusororo | RT, WP | Shrub | Enchantments using roots. Decoction drunk or powder/poultice applied topically. Plant powder applied topically. | Uganda, Tanzania | [24, 35, 37, 38, 82] |
| Indigofera  | Indigofera capitata Forsk. | Yat twol (Luo), Awee dyang, Ocukulak (Lango) | RT, L, shoot | Herb | Pound and drink juice and apply topically | Uganda | [35, 36] |
| Indigofera  | Indigofera circinella Baker f. | Odolo (Luo) | L | Herb | Poultice chewed and pasted on the bite | Kenya | [30, 31] |
| Indigofera  | Indigofera garckeana Vatke | Mukitimbo (Lusoga) | RT | Shrub | Chewed or infusion drunk | Uganda | [24, 83] |
| Lonchocarpus  | Lonchocarpus bussei Harms | Enahl (Boni) | Bk | Tree | Used to make a tourniquet that is applied below the snake bite | Kenya | [26] |
| Lonchocarpus  | Lonchocarpus capassia | Mkunguga (Luguru) | WP | Tree | Not reported | Tanzania | [34] |
| Lonchocarpus  | Lonchocarpus laxiflorus Guili. & Perr | Eputon (Ateso) | RT | Tree | Chewed to induce vomiting | Uganda | [35] |
| Millettia  | Millettia usaramensis Taub. | Mfutumubula (Sukuma) | RT | Shrub | Not reported | Tanzania | [26] |
| Ormosia  | Ormosia trachycarpum | Ederut (Ateso) | RT | Shrub | Infusion drunk | Uganda | [51] |
| Phaseolus  | Phaseolus lunatus L. | Kayindiyindi (Luganda) | WP | Herb | Decoction drunk/paste applied on bite | Uganda | [21] |
| Phaseolus  | Phaseolus radiatus L. | Choroko (Swahili) | SD | Herb | Powder with honey & rubbed on incisions | Tanzania | [33] |
| Pilostigma  | Pilostigma (Luo) | Ogali (Luo) | L, BK | Tree | Decoction | Uganda | [35] |
| Plant family | Botanical name | Local name(s) | Part(s) | Habit | Mode of preparation/administration | Country | Authors |
|-------------|----------------|--------------|--------|-------|-----------------------------------|---------|---------|
| Lamiaceae   | *Hyptis pectinata* (L.) Poit. | Gidha (Hindi), Elukse (Kikuyu), Malon (Swahili) | L | Shrub | Infusion drunk | Tanzania | [34, 35] |
|             | *Hoslundia opposita* Vahl | Not specified | L | Shrub | Decoction drunk/rubbed on the bite | Uganda, Tanzania | [24, 34, 35] |
|             | *Hypitis pectinata* (L.) Poit. | Not specified | L | Herb | Infusion with *Corchurus trilocularis* L. is dropped/sprinkled into the eye | Kenya | [30] |
|             | *Pilostigma reticulatum* (DC.) Hochst. | Etutu (Tutsi), Kibungu (Swahili) | SB | Tree | Decoction taken/powder pasted on the bite | South Sudan | [76] |
|             | *Pilostigma thomsonii* (Schumach.) Milne-Redh. | Ogal (Acholi), Michikichiki (Swahili), Murema (Kikuyu) | L (dry) | Tree | Ash spread over wound sustained from snake bite in order to facilitate healing | Uganda, Kenya | [26] |
|             | *Pseudanthia hookeri* Wight & Arn. | Luganila (Lusoga) | Rt | Shrub | Infusion drunk | Uganda | [24, 84] |
|             | *Rhyynchosia stellatum* (Forssk.) Brenan | Kibai (Mera), Kormande (Tugen), Osirimatindo (Luo) | St, Rt, Bk | Herb | Stem chewed as an emetic. Roots and bark used as antidotes | Tanzania | [26] |
|             | *Senna alata* (L.) Roxb. | Eulfa (Luganda) | L | Tree | Paste applied on the bite | Uganda | [21] |
|             | *Senna hirsuta* (L.) H.S.Irwin & Barneby | Elekumare (Ateso) | Rt | Tree | Mix the powder with cold water and drink 3 times daily for at least 3 days | Uganda | [35] |
| Iridaceae   | *Gladiolus dalenii* Van Geel | Lodokole (Karamojong) | Bk | Herb | Powder applied once on incisions/decoction drunk | Uganda | [35] |
|             | *Clerodendrum myricoides* R. Br. | Umukuzanyama | Bk | Shrub | Not reported | Tanzania | [82] |
|             | *Clerodendrum scheffleri* | Mkuga (Sukuma) | L | Herb | Crushed and filtered infusion drunk | Kenya | [30, 31, 85] |
|             | *Fuerstia africana* T.C.E. Fr. | Abunga-usoke, aremo (Luo) | L | Herb | Crushed and filtered infusion drunk | Kenya | [30, 31, 85] |

| Part (s) | Habit | Country | Authors |
|---------|-------|---------|---------|
| SB      | Tree | South Sudan | [76] |
| L       | Tree | Uganda, Kenya | [26] |
| St, Rt, Bk | Herb | Tanzania | [26] |
| L | Tree | Uganda, Kenya | [24, 39] |
| Sd, L | Tree | Uganda, Tanzania | [34, 35] |
| L | Shrub | Tanzania | [26, 28] |
| Bk | Herb | Uganda | [35] |
| Bk | Shrub | Tanzania | [26] |
| L | Herb | Kenya | [30, 31, 85] |

- **Part(s)**: Herb, Shrub, Tree
- **Habit**: Infusion, Decoction, Crushed and filtered
- **Mode of preparation/administration**: Powder applied, Paste applied, Crushed and packed, Infusion drunk, Chewed and juice swallowed, Ash spread, Warm water decoction, Paste applied on the bite, Rubbed on the bite, Sprinkled into the eye, Infusion drunk, Powder applied on the bite, Not reported, Decoction drunk, Powder applied topically, Stem ash swallowed, Chalybeum, Mixed with...
| Plant family | Botanical name | Local name(s) | Part(s) | Habit | Mode of preparation /administration | Country | Authors |
|--------------|----------------|---------------|---------|-------|------------------------------------|---------|---------|
| Lauraceae    | Cassytha filiformis L. | Hauna shina (Zaramo), Mlangamia (Nyami wezi) | WP | CL | Not reported | Tanzania | [23, 34] |
| Liliaceae    | Anthuricum cameronei Bak | Yat twol ororo (Lango) | RT | Shrub | Not reported | Uganda | [36] |
| Linaceae     | Hugonia castaneifolia Engl. | | Not reported | WP | CL | Not reported | Kenya | [87] |
| Loganiaceae  | Strychnos henningsii Gilg | | | | | | |
|              | Strychnos innocua Del. | Akwalaalowala (Lango), Bungundu (Bende), Lumbora (Madi), Mhindu (Sukuma) | Fresh RT | Shrub | Not reported | Uganda, Tanzania, Kenya | [26, 28, 36, 88] |
|              | Strychnos pungens Soler. | Mkole (Swahili) | NS | Tree | Not reported | Tanzania | [23] |
|              | Strychnos spinos Lam. | Mtonga (Swahili), Muhong, Mukonga, Murasapungu (Digo) | RT | Tree | Chewed or decoction drunk | Kenya, Tanzania | [23, 26] |
|              | Strychnos volkensii Gilg | Muage, Muage (Nyami wezi) | RT | Tree | Not reported | Tanzania | [23] |
| Loranthaceae | Erintherumum dregel (Eckl. & Zeyh.) Tiegh | | Not reported | Bk | Shrub | Pounded bark applied on snake bite wounds | Kenya | [41] |
|              | Loranthus dregel Eckl. & Zeyh. | Nyulukesi (Sukuma) | Bk | CL | Chewed. Decoction is drunk/used for washing wound | Tanzania | [26] |
| Lythraceae   | Punica granatum L. | Enkomamawanga (Uganda) | WP | Tree | Paste applied on the bite | Uganda | [21] |
| Malvaceae    | Corchurus trilocularis L. | Apoth (Luo) | L | Herb | Infusion with H. pectinata used as eyedrops to neutralize venom ejected into human eyes | Kenya | [30, 31] |

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| Plant family | Botanical name | Local name (s) | Part (s) | Habit | Mode of preparation /administration | Country | Authors |
|--------------|----------------|----------------|----------|-------|-------------------------------------|---------|---------|
| Meliaceae    | Grewia bicolor Juss. | Esteti (Masai), Mulawa (Kamba), Mkone (Swahili) | Rt | Shrub | Gold infusion drunk | Kenya, Tanzania | [26, 48, 66, 89] |
|              | Grewia damine Gaertn. | Enkomakoma (Luganda), Ositeti | Bk, Rt, St, Fr, Br, WP | Shrub | Whole plant is eaten | Uganda, Kenya | [21, 90] |
|              | Grewia falax K. Schum. | Powo (Luo), Ilawa (Kamba), Kamagere (Sukuma) | L, Bk, Rt | Shrub | Used in cooking envenomed carcass to prevent secondary poisoning. Crushed L used to wipe the bite. Rt chewed/ decoction taken | Kenya, Tanzania | [26, 30, 31, 48] |
|              | Grewia similis K.Schum. | Not reported | Bk | Tree | Pounded and applied on bite wound | Kenya | [41] |
|              | Grewia truncata Mast. | Msensemazi (Sukuma) | L, Rt | Shrub | Chewed/decoction taken | Tanzania | [26] |
|              | Hibiscus micranthus L. | Muanbe (Swahili), Maharasha-mbuzi (Ziga), Mburi (Sukuma) | Rt, WP, L | Shrub | Rt decoction taken. Fresh WP/L infusion applied to incisions on the bite | Tanzania | [23, 78] |
| Melastomataceae | Hibiscus sabdariffa L. | Karkadeh | Fl (calyx) | Herb | Decoction taken | South Sudan | [91] |
|              | Sida alba L. | Minyundimi (Sukuma), Omucundezi | L | Shrub | Decoction drunk or smear/tie the residue on bite. Chewed and the juice swallowed | Uganda, Tanzania | [26, 28, 38] |
|              | Sida rhombifolia L. | Rushuhya (Haya), Ugafio (Swahili) | Rt | Shrub | Not reported | Tanzania | [34] |
|              | Sida veronicifolia Lam. | Ehoza | L | Shrub | Powder mixed with vaseline smeared on bite/ three spoons of decoction taken | Uganda | [38] |
|              | Triumphetta rhomboidea Jacq. | Muinda nguee(Kamba), Kulibha (Kerewe) | Rt, L | Herb | Infusion drunk/applied on bite. Leaf powder tied to bite; decoction taken once | Kenya, Tanzania | [30, 33, 39] |
|              | Urena lobata L. | Bikadantama (Lusoga) | L | Herb | Not reported | Uganda | [24] |
| Meliaceae    | Tristemma mauritianum J.F. Gmel. | Alwedo, Alea (Lango) | Rt | Tree | Not reported | Uganda | [36] |
|              | Azadirachta indica A. Juss. | Omuttankuyege (Luganda) | Fr | Tree | Decoction taken, paste applied on the bite | Uganda, South Sudan | [21, 35] |
|              | Ekebergia capensis Sparrm | Akwirakir (Lango) | Rt, L | Tree | Decoction taken | Uganda | [92] |
|              | Pseudodendrela kotschyi (Schweinf.) Harms | Ekaka (Ateso) | Rt | Shrub | Powder applied topically/decoction drunk | Uganda | [35] |
|              | Toona ciliata M. Roem. | Yat bwoc (Luo) | Rt | Tree | Infusion drunk once | Uganda | [35] |
|              | Trichilia ematica Vahl | Akwirakir (Lango) | Rt, L | Tree | Rt infusion with M. foetida Rt drunk. Leaves rubbed on cuts | Uganda | [56, 57] |
| Menispermaceae | Cissampelos micronota A. Rich. | Kavangambo (Lusoga), Omanobyaya (Lango), Kishiki Cha Buga (Swahili), Olandra (Luo) | Rt, RB, L, Fr (cover) | Tree | Pound leaves and tie on affected part. RB is chewed, and juice swallowed | Uganda, Kenya, Tanzania | [26, 36, 37, 75] |
|              | Cissampelos pareira L. | Moeru (Rufiji), Msimbasi (Sukuma), Malutatito (Pokot) | L, Rt | Liana | Leaves powdered and mixed with water then taken or simply chewed. Powdered roots used | Tanzania, Kenya | [26, 41, 75] |
|              | Cissampelos truncata | Nyakasihio (Rufiji), Shikio Ya Paka (Swahili) | Rt | Liana | Chewed. Chewed Rt placed on the snakebite wound | Tanzania | [26] |
| Plant family | Botanical name | Local name(s) | Part(s) | Habit | Mode of preparation /administration | Country | Authors |
|-------------|----------------|---------------|---------|-------|-------------------------------------|---------|---------|
| Pinaceae    | _P. radiata_   | _P. radiata_  | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. thunbergii_ | _P. thunbergii_ | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. elliottii_ | _P. elliottii_ | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. pinaster_  | _P. pinaster_ | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. abies_     | _P. abies_    | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. sylvestris_ | _P. sylvestris_ | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. menziesii_ | _P. menziesii_ | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. nigra_     | _P. nigra_    | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. glauca_    | _P. glauca_   | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. jackii_    | _P. jackii_   | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. koraiensis_| _P. koraiensis_ | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. obovata_   | _P. obovata_  | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. mugo_      | _P. mugo_     | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. sitchensis_| _P. sitchensis_ | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. contorta_  | _P. contorta_ | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. radiata_   | _P. radiata_  | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. thunbergii_| _P. thunbergii_ | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. elliottii_ | _P. elliottii_ | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. pinaster_  | _P. pinaster_ | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. abies_     | _P. abies_    | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. sylvestris_| _P. sylvestris_ | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. menziesii_ | _P. menziesii_ | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. nigra_     | _P. nigra_    | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. glauca_    | _P. glauca_   | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. jackii_    | _P. jackii_   | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. koraiensis_| _P. koraiensis_ | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. obovata_   | _P. obovata_  | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. mugo_      | _P. mugo_     | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. sitchensis_| _P. sitchensis_ | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. contorta_  | _P. contorta_ | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. radiata_   | _P. radiata_  | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. thunbergii_| _P. thunbergii_ | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. elliottii_ | _P. elliottii_ | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. pinaster_  | _P. pinaster_ | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. abies_     | _P. abies_    | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. sylvestris_| _P. sylvestris_ | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. menziesii_ | _P. menziesii_ | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. nigra_     | _P. nigra_    | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. glauca_    | _P. glauca_   | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. jackii_    | _P. jackii_   | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. koraiensis_| _P. koraiensis_ | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. obovata_   | _P. obovata_  | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. mugo_      | _P. mugo_     | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. sitchensis_| _P. sitchensis_ | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. contorta_  | _P. contorta_ | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. radiata_   | _P. radiata_  | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. thunbergii_| _P. thunbergii_ | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. elliottii_ | _P. elliottii_ | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. pinaster_  | _P. pinaster_ | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. abies_     | _P. abies_    | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. sylvestris_| _P. sylvestris_ | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. menziesii_ | _P. menziesii_ | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. nigra_     | _P. nigra_    | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. glauca_    | _P. glauca_   | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. jackii_    | _P. jackii_   | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. koraiensis_| _P. koraiensis_ | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. obovata_   | _P. obovata_  | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. mugo_      | _P. mugo_     | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. sitchensis_| _P. sitchensis_ | L       | Herb  | Fresh stem         | Uganda   | [26]    |
|             | _P. contorta_  | _P. contorta_ | L       | Herb  | Fresh stem         | Uganda   | [26]    |
| Plant family     | Botanical name                                        | Local name (s) | Part (s) | Habit                        | Mode of preparation /administration | Country            | Authors          |
|------------------|------------------------------------------------------|----------------|----------|------------------------------|-------------------------------------|--------------------|------------------|
| Rosaceae         | Antidesma venosum E.Mey. ex Tul.                    | Chikura (Digo). Mnyamara (Vidanda), Musaga (Swahili) | Rt, Bk   | Tree                         | Chewed. It is a very bitter         | Kenya, Tanzania    | [26, 89]        |
| Phyllanthaceae   | Flueggea virosa (Roxb. ex Willd.) Royle             | Ołukandwa (Luganda) | Rt       | Shrub                        | Chewed/eaten                        | Uganda             | [21]            |
|                  | Phyllanthus modestospatensis                         | Mkasiri (Mwera)  | Rt       | Herb                         | Not reported                         | Tanzania           | [26]            |
|                  | Phyllanthus ovalifolius Forssk.                      | Elakas (Ateso)   | Rt       | Shrub                        | Infusion drunk thrice daily for 3 days/apply topically | Uganda            | [35]            |
|                  | Phyllanthus reticulatus Poir.                        | Mkwamba-mazi (Swahili, Zaramo) | L       | Shrub                        | Infusion taken                       | Tanzania           | [75]            |
| Poaceae          | Phytolacca dodecandra L. Hiern                      | Kupsogotit       | L, Fr    | Shrub                        | Burnt, chewed                       | Kenya              | [71]            |
|                  | Brachiaria repitana (L.) Gardner                    | Lukoka (Pare)    | WP       | Herb                         | Burnt and ashes applied topically   | Tanzania           | [75]            |
|                  | Cynodon dactylon (L.) Pers                          | Akacwamba        | L        | Herb                         | Tie above the affected area         | Uganda             | [38]            |
|                  | Cynodon species                                     | Omucwamba        | WP       | Herb                         | Tied or pound and smear on the bite | Uganda             | [38]            |
|                  | Imperata cylindrica (L.) P. Beauv                    | Obiya (Ateso/Luo), Essenke (Luganda), Omushojoya      | St, L, Rt| Herb                        | Decoction drunk 250 ml daily for stem. tied above the affected area. Chewed | Uganda, Tanzania   | [21, 24, 35, 37, 38] |
|                  | Pennisetum purpureum Schumach                       | Ekbingo, Urubingo | L, WP    | Herb                         | Decoction drunk, smear the residue on affected area. Plant powder with other herbs is applied on the bite | Uganda, Tanzania   | [38, 82]        |
|                  | Sporobolus pyramidalis P. Beauv.                    | Alioc (Lango), Nakaselye (Lusoga), Chinswi, Kurumuzya (Kerewee) | Rt, L    | Herb                         | Decoction taken 3 times a day       | Uganda, Tanzania   | [24, 33, 35]    |
| Polygalaceae     | Polygala wadibonica Chodat                          | Kiguru (Sukuma)  | Rt       | Herb                         | Chewed and swallowed                | Tanzania           | [26, 28]        |
|                  | Secardula longipedunculata Fresen                    | Omukondwa (Lusoga), Avee illa (Lango), Ellowi (Ateso), Mbaso Nengongo (Sukuma) | L, RB   | Shrub                        | Infusion drunk                   | Uganda, Kenya, Tanzania | [23, 24, 36, 51, 83, 93] |
| Portulacaceae    | Portulaca oleracea L.                                | Mkoga (Rufiji), Loirabrab (Dorobo)                     | Rt       | Shrub                        | Chewed, or decoction applied on to wounds | Tanzania           | [26]            |
|                  | Portulaca quadrifida                                | Bwanda (Luganda) | WP       | Herb                         | Juice added to other plants and drunk | Uganda             | [21]            |
| Primulaceae      | Maesa lanceolata Forssk.                            | Katera (Luo), Ribotio (Markwt), Mushebeshebe (Luhya)  | Rt       | Tree                         | Decoction administered as a follow up for puff adder bites | Kenya             | [30, 31, 41]    |
| Pteridaceae      | Pellaea viridis (Forsk.) Pranth.                    | Not reported    | L        | Herb                         | Pulped and rubbed on the bite       | Kenya              | [30, 31]        |
| Ranunculaceae    | Thalictrum rhynochocarpum Dillon ex. A. Rich        | Ubogombooro (Kinyarwanda)                              | L        | Herb                         | Juice taken                        | Rwanda             | [94]            |
| Rhamnaceae       | Rhamnus prionoides L. Herit                         | Kinyil (Samburu) | Rt       | Shrub                        | Decoction in soup is taken          | Kenya              | [95]            |
|                  | Ziziphus mucronata Wildl.                            | Ilegero (Sukuma), Lang’o (Luo), Nonoiywa (Markwt)     | Rt       | Shrub                        | Infusion drunk. Powder used         | Kenya, Tanzania    | [26, 28, 41, 66] |
| Rosaceae         | Rubus pinnatus                                      | Enkemene (Luganda), Liana                             | L, Liana | Chewed/roasted                |                                     | Uganda             | [21, 38]        |
| Plant family | Botanical name                                      | Local name(s)                   | Part(s) | Habit     | Mode of preparation /administration | Country   | Authors |
|--------------|----------------------------------------------------|---------------------------------|---------|-----------|--------------------------------------|-----------|---------|
| Wild.        | Enkyerer                                           |                                 |         |           | ground with rock salt and 250 ml drunk thrice daily or powder is smeared on the bite | Uganda    | [37]    |
| Rubus rigidus Sm | Kawule (Luganda)                              | L Shrub                         |         |           | Crush and tie on affected area       | Uganda    | [37]    |
| Agathisanthemum bojeri Klotzsch | Chivuma Nyuki, Kwuma Nyuki (Digo), Moomanyuki (Swahili) | L Shrub                         |         |           | Chewed                               | Kenya     | [26]    |
| Catanaragam nilotica (Stapf) Tirvengadum | Mdasha (Zigua), Mwachanguku (Sukuma) | SB Shrub                        |         |           | Infusion drunk                       | Tanzania  | [96]    |
| Chassalia buchwaldii/K. Schum. | Not reported                                     | Rt Tree                         |         |           | Not reported                         | Kenya     | [26]    |
| Gardenia jovis-tonantis (Welw.) Hiern | Geninyet (Maasai)                              | Rt Shrub                        |         |           | Infusion taken which leads to heavy vomiting | Kenya     | [26]    |
| Gardenia ternifolia Schumach. & Thonn. | Ekoroi (Ateso), Odwong (Luo), Lukoole, Kawanu (Lusoga) | Rt Tree                        |         |           | Gold water infusion drunk thrice a day for at least 3 days/applied topically | Uganda    | [24,35] |
| Gardenia volkensii K. Schum. | Mogililo (Markweta)                             | L Tree                          |         |           | Mixed with those of P. barbatus and E. divinorum. Powder is applied on incisions | Kenya     | [72]    |
| Hymenodictyon parvifolium Oliv. | Mluhindi (Pare)                                  | L, Rt Shrub                     |         |           | Crushed and infusion drunk           | Kenya, Tanzania | [26,97] |
| Oldenlandia Bojeri Hiern. | Mkuuku pingua (Nyamwezi)                        | L Herb                          |         |           | Not reported                         | Tanzania  | [23]    |
| Oldenlandia herbacea (L.) Rosb. | Kayitaneva (Lusoga), Lambula (Lukiga)            | Rt Herb                         |         |           | Not reported                         | Uganda    | [26]    |
| Pavetta species | Kipolopol (Hehe)                                | L Tree                          |         |           | Decoction taken to induce vomiting   | Tanzania  | [26]    |
| Psychotria eminiata (Kunte) E.M.A. Petit | Mhalah (Sukuma)                                | Rt Tree                         |         |           | Chewed when fresh and juice swallowed. Infusion taken and also applied on the bite | Tanzania  | [26]    |
| Tricalysia ovalifolia Hier n | Mpondua Nguku (Sukuma)                          | Rt Tree                         |         |           | Chewed when fresh and juice swallowed. Infusion taken and also applied on the bite | Tanzania  | [26]    |
| Vangueria rotandata Robyns | Not reported                                    | Rt Shrub                       |         |           | Powder mixture with roots of Markhamia obusifolia and C. mole applied topically | Tanzania  | [64]    |
| Vangueria tomentosa Hochst. | Mvilu (Shambaa)                                 | Rt Shrub                        |         |           | Chewed                                | Tanzania  | [26]    |
| Xeromphis nilotica (Stapf) Keay | Mtwuma (Zaramo), Papa (Makua)                    | Rt Shrub                        |         |           | Not reported                         | Tanzania  | [26]    |
| Xeromphis obovata (Hochst.) Keay | Mbasho (Zigua)                                  | Rt Shrub                        |         |           | Not reported                         | Tanzania  | [26]    |
| Rutaceae    |                                                     |                                 |         |           |                                      |           |         |
| Citrus limon L. Burm. P | Milamo                                           | L Tree                          |         |           | Not reported                         | Tanzania  | [74]    |
| Citrus sinensis (L.) Osbeck | Enmiimu (Luganda), Amacunga (Lango), Mucungwa (Lusoga) | Fr (& fr peel), Rt Tree        |         |           | Squeeze out juice and drink. Roots chewed or infusion drunk | Uganda    | [21, 24, 35] |
| Clausena anisata (Wild.) Hook.f. | Omutanu                                         | L Shrub                         |         |           | Boil with rock salt and drink 250 ml or dry, grind and smear powder on bite    | Uganda    | [38]    |
| Plant family | Botanical name | Local name(s) | Part(s) | Habit | Mode of preparation/administration | Country | Authors |
|-------------|---------------|---------------|---------|-------|------------------------------------|---------|---------|
| Fagoropsis angolensis (Engl.) Dale | Omumara (Rutoro) | B | Tree | Decoction taken | Uganda | [98] |
| Tectea sansibarensis Engl. | Msajepasjepa (Swahili) | RB | Shrub | Not reported | Tanzania | [23] |
| Toddalia asiatica (L.) Lam | Mururue, Mwikukenya (Kikuyu), Ajua (Luo), Mkuro, Chui (Digo), Mdakakomba (Swahili) | RB, RT, SB | Liana | Infusion taken. Rt juice rubbed onto incisions around the wrists and ankles and taken for snakebite-induced paralysis | Uganda, Kenya | [26, 99] |
| Zanthoxylum chalybeum Engl. | Oloisuki (Massai), Eusuk (Ateso), Songoiywa (Markwet) | RT, ST, L | Tree | Rt used with Senna siamea. Rt. Decoction drunk thrice daily for at least 3 days/applied topically | Kenya, Uganda | [26, 30, 35, 41] |
| Zanthoxylum gillettii (De.Wild) Waterman | Sagawatiet (Nandi) | BK, RT | Tree | Decoction | Kenya | [27] |
| Salvadoraceae | Azima tetracantha Lam. | Mdanga Ndewe (Swahili), Mwelewele (Nyamwezi) | RT, L | Shrub | Pounded, rubbed onto the wound. Infusion drunk | Kenya, Tanzania | [23, 26] |
| Sapindaceae | Cardioperum corundum L. | Tignomi (Samburu), Loitegomi (Dorobo) | RT | Shrub | Decoction taken. Boiled and mixed with sheep fat and applied to the bite wound | Kenya, Tanzania | [26, 95] |
| | Paulinia pinnata L. | Mgogote (Sukuma) | L, RT | Tree | Roots used as a styptic | Tanzania | [26, 28] |
| | Zanha golungensis Hiern | Ekiya Lo’emun (Ateso) | RT, ST | Tree | Pound, mix with water and drink twice | Uganda | [35] |
| Sapotaceae | Manilkara sulcata (Engl.) Dubard | Mbiriri (Sukuma) | RT, FR | Shrub | Fruit extracts taken | Kenya, Tanzania | [26, 53] |
| Simaroubaceae | Harrisonia abyssinica Oliv. | Akere (Lango), Ekeroi (Ateso), Luzhake (Lusoga), Mkotoromado (Swahili), Mkuusu (Sukuma) | LT | Shrub | Leaf decoction (or with roots). Infusion is taken | Uganda, Kenya, Tanzania | [23, 24, 26, 36, 51] |
| | Capsicum annuum L. | Kamulari (Luo), Emulali (Ateso) | FR, L | Herb | Chewed/powdered, mixed with cold water and drunk 3 times a day for at least 3 days/applied topically | Uganda | [35] |
| | Datura metel L. | Mnanaha (Swahili) | RT | Shrub | Chewed and the juice swallowed | Tanzania | [26, 28] |
| Solanaceae | Datura stramonium L. | Yat twol (Lang) | RT, L, FR | Shrub | Not reported | Uganda | [36] |
| | Nicotiana tabacum L. | Taaaba (Lango, Luganda, Lusoga), Echimani (Rutoro) | L, R | Herb | Squeeze and tie on the affected area. Eat to vomit the venom | Uganda | [24, 37, 38, 98] |
| | Physalis minima L. | Akattuuti | L | Herb | Powder smeared on the bite | Uganda | [38] |
| | Solanum aculeastrum Dunal | Entengo (Luganda), Acokocok Lango (Lango) | FR, RT, L | Shrub | Eaten immediately | Uganda | [21, 36, 99] |
| | Solanum aculeatissimum Jacq. | Not reported | RT, FR | Shrub | Infusion drunk | Uganda | [57] |
| | Solanum giganteum Jacq. | Ocok (Luo) | RT, L | Shrub | Decoction drunk. Powder applied topically. Dry leaf steam inhaled | Uganda | [35] |
| | Solanum incanum L. | Ocokococok (Lango), Ntorka (Lusoga), Akatengotengo (Luganda), Mutongu | L, ST, FR, RT, WP | Shrub | Young leaves chewed/rubbed hard/applied to bite. St/Fr powder applied. Fr sap | Uganda, Kenya, Tanzania | [21, 23, 24, 26, 30, 35, 36, 46] |
| Plant family | Botanical name | Local name(s) | Part(s) | Habit | Mode of preparation/administration | Country | Authors |
|-------------|----------------|--------------|---------|-------|-----------------------------------|---------|---------|
| Thymelaeaceae | Synaptoplepis kirkii Oliv. | Mjirambiri (Digo) | Rt | Shrub | Chewed. Induces vomiting | Kenya | [26] |
| Thymelaeaceae | Xerophyta spekii Baker | Kianduri | WP | Shrub | Ashes applied to the bite | Kenya | [44] |
| Verbenaceae | Lantana camara L. | Owinybilo (Lango), Kanpanga (Ateso) | Rt, L | Shrub | Decoction taken (250 ml for roots) | Uganda | [51, 57] |
| Violaceae | Rinorea elliptica (Oliv.) Kurz | Mherengi (Sukuma), Mhunduri (Swahili) | Rt | Shrub | Chewed and the juice swallowed | Kenya, Tanzania | [26, 28, 53] |
| Vitaceae | Cissus hildebrandtii Gilg. | Masango (Shambaa) | L | Cl | Juice used | Tanzania | [23] |
| Vitaceae | Cissus quadrangularis L. | Sala sala | WP | Cl | Not reported | South Sudan | [54] |
| Vitaceae | Cyphostemma adenocaule | Anuno (Luo) | Rt | Herb | Decocted taken | Uganda | [35] |
| Vitaceae | Cyphostemma cyphopetalum | Anona (Kumam) | Rt | Herb | Squeezed juice taken | Uganda | [35] |
| Zingiberaceae | Aframomum mildbraedii Loes. | Acac/Asawot (Ateso), Oceyo (Kumam), Oceyo (Luo) | Rt | Herb | Juice drunk/infusion with C. cyphopetalum is drunk/applied topically | Uganda | [35] |
| Zingiberaceae | Aframomum sanguineum (K.Schum.) K.Schum. | Menyua (Meru), Mtangawizi (Digo), Oseyo (Padhola) | Rt | Herb | Decoction taken | Uganda, Kenya | [26] |
| Zygophyllaceae | Balanites aegyptiaca (L.) Delile | Ng’oswo | NS | Tree | Not reported | Kenya | [81] |

*Parts used.* AP: Aerial parts, Blb: Bulb, Br: branches, Bk: bark, L: leaves, Fl: flowers, Fr: Fruit, MP: Multiple parts, SB: Stem bark, Sd: Seeds, St: stem, RB: Root bark, Rt: roots, WP: Whole plant, NS: Not specified. *Growth habit.* CL: climber

**Figure 1:** Major botanical families from which antivenom remedies are obtained in East Africa
The genera with the highest recorded number of antivenom plant species in East Africa are *Combretum* (9 species), *Senna* (6 species), *Acacia*, *Commiphora*, *Euphorbia*, *Grewia*, *Solanalum*, *Styrchnos* and *Vernonia* (5 species each), *Aristolochia*, *Cassia*, *Indigofera*, *Jasminum* and *Sansevieria* (4 species each). The most used species were *Solanalum incanum* L. (11 times), *Combretum molle* G. Don (10 times), *Allium cepa* L. (8 times), *Annona senegalensis* Pers., *Securidaca longipedunculata* Fres., *Steganotaenia araliacea* Hochest. (6 times), *Combretum collinum* Fresen., *Dichrostachys cinerea* L., *Euclea divinorum* Hiern, *Euphorbia tirucalli* L., *Indigofera arrecta* Host. A. Rich., *Imperata cylindrica* (L.) P. Beauv., *Harrisonia abyssinica* Oliv., *Trichodesma zeylanicum* (L.) (Burm.f) R.Br. (5 times), *Brackenridgea zanguebarica* Oliv., *Cissampelos mucronata* A. Rich., *Entada leptostachya* Harms, *Ficus natalensis* Hochst, *Grewia bicolor* Juss., *Grewia fallax* K. Schum., *Jasminum fluminense* Vell., *Nicotiana tabacum* L., *Ovariodendron anisatum* Verdc., *Solanecio mannii* (Hook.f) C. Jeffrey, *Styrchnos innocua* Del., *Zanthoxylum chalybeum* Engl. and *Ziziphus mucronata* Willd. (4 times each).

Out of the plants identified, no plant was reported from Burundi, while Rwanda, South Sudan, Tanzania, Kenya and Uganda had 1, 12, 154, 94, and 162 species reported, respectively. A comparison of plant usage demonstrated that South Sudan and Uganda shared 1 species (*Azadirachta indica* A. Juss.), Uganda and Kenya shared 21 species, Uganda and Tanzania shared 13 species, while Tanzania and Kenya shared 18 species. A total of 10 plant species were recorded to be shared by Uganda, Kenya and Tanzania. The disparity in plant usage across the countries could be due to the choice of medicinal plants utilized by traditional medicine practitioners is based on complex mechanisms [100]. Plant scent and appearance (such as possession of aerial roots reminiscent of a snake) may influence the choice of a plant used in snakebite therapy [35, 101, 102]. In addition, the differences in plant usage are more likely due to the climatic and soil variations that is known to account for variations in species distribution and phytochemical composition of the same plant species in different geographical locations [103]. This disparity could also be due to variations in the knowledge and experiences of antivenom therapy resulting from differences in the social and cultural backgrounds in the East African community [104]. Uganda had the highest number of plant species reported because it had more ethnobotanical reports, two of which reported exclusively on ethnomedicinal plants used in treating snakebites [21, 35] as compared to Tanzania and Kenya which had one study each reporting on antivenom plants only [30, 33].

**Habit, used part(s), mode of preparation and use of antivenom plants in East Africa**

The herbal remedies are primarily from roots (47.4%) and leaves (27.7%) (Figure 2) of herbs (117 species, 33%), trees (114 species, 32%) and shrubs (102 species, 29%) (Figure 3). In contrast, generative parts such as fruits, seeds, buds, bulbs and flowers which are known for accumulating phytochemicals are not often used and this is in congruence with reports from other countries [105, 106]. The regular use of roots and leaves in antivenom preparations is a characteristic feature of traditional antivenom therapy [34, 105, 107]. The frequent use of roots could also be related to the fact that snakebites’ effects are internal to the body, is hidden, and so are the roots of plants below the ground. This gives a correlation to the doctrine of signature concept i.e. herbs with shape or colour resemblances to body parts could be used to manage ailments of those body parts [108]. Indeed we identified that this pharmacognostical tenet, first postulated by Paracelsus (1490-1541) [109], existing in East African antivenom venom therapy. *Hugonia castaneifolia* Engl. (a climber) with snake-like crawling characteristics was reiterated as a revered source of herbal remedy for treatment and protection against snakebites in Kenya [87]. In Uganda, Okot *et al.* [35] reported of a herbalist using *Opilia amentacea* Roxb. for treating snakebites because of the scale-like and dotted
appearance of its bark, and its creeping habit. In addition, the same authors identified a case of zoopharmacognosy in snakes using *Microglossa pyrifolia* (Lam.) O. Kuntze [35]. Zoopharmacognosy has been previously reported in chimpanzees in Uganda [110] and led to the identification of important medicinal plants as well as isolation of therapeutic pure compounds [111]. Though the doctrine of signatures has often received scientific criticisms/scepticisms [112, 113], the cases of doctrine of signatures and zoopharmacognosy could be further explored in the identified plants.

![Figure 2: Frequency of the reported plant parts used for preparation of antivenom remedies in East Africa](image)

![Figure 3: Growth habit of antivenom plants used across East African communities as per reports of ethnobotanical surveys](image)

Indigenous herbal antisnake venom remedies in East Africa are prepared as poultices (30%), decoctions (21%), infusions (20%) or steam (0.4%), though sometimes the collected plant materials are used directly (16%) (Figure 4). Decoctions, infusions, squeezed juices, saps or latexes may be taken orally (47%), applied topically to the bites (34%), eaten/chewed directly, after crushing, drying or pounding (19%). Remedies for topical application as poultices, ointments, and liniments are frequently percutaneous, by rubbing or bandaging which are occasionally complimented by massage. For example, *Combretum molle* leaves are placed on the wound on which has been applied *Senecio lyratipartitus* root powder and banana leaves are
used as bandage. Conversely, antivenom remedies are not usually administered through the nasal route; only Solanum giganteum (dry leaves) and Strophanthus eminii (root powder) were reported to be administered by inhalation of their steam (0.5%). Some treatments, however, involve use of spiritual, magical or scientifically unexplainable remedies. Indigofera arrecta roots for instance is used with enchantments in the treatment of snakebites in Uganda [38]. For Toddalia asiatica, after taking juice from its roots, the victim must also bite the part that was bitten by the snake [26]. Though uncommon, sometimes plant materials and non-plant materials are mixed in the treatment procedures. A citation was made of the inclusion of recipes such as “head of a snake”, a thorn and blood from a slaughtered black chicken during the preparation of a potential remedy used for management and protection against snakebites [87]. Snake “teeth” was also reported to be crushed and mixed with powder of burnt Opilia amentacea roots and applied topically to snakebite wounds [30].

![Figure 4: Methods used for preparation of herbal remedies used in treating snake poisons in East African community as per reports of ethnomedical surveys](image)

Some plants such as Drimia maritima (L.) Stearn (bulb) and Sigesbeckia orientalis L. (leaves) had their routes of administration indicated in the use reports to hint that internally mediated antivenom effects would be unlikely when such plant remedies are taken orally. Other reported species (13%) did not have details on how they are used in treating snakebites. Furthermore, we noted that some species used for treating snake poisons were also utilized as snake baits or for dissuading snakes. Other species are specifically used for these, rather than being used as antivenom remedies (Table 2). A distinguished example is Sansevieria intermedia (leaf sap) employed as a bait for killing snakes in Kenya [70]. Against this background, we emphasize the relevance of capturing fine details of medicinal plants such that knowledge of a traditional use can be more specific (e.g. to alleviate snakebite pains and/or panic or improve the survival of envenomed victims). In some use reports, the administration modes were simply generalized as utilized against/for snakebites. Collection of specific and detailed ethnomedical data could also aid in the choice of the most appropriate pharmacological tests to use in validating the claimed use of these plants in snakebite treatment.

### Table 2: Plants used in East Africa for repelling/ killing snakes

| Family          | Botanical name | Habit | Part used | Mode of use to kill/dissuade snakes | References |
|-----------------|----------------|-------|-----------|------------------------------------|------------|
| Amaryllidaceae  | Allium cepa L. | Herb  | Bulb      | Decoction made and sprinkled around the house. Snakes are dissuaded by the citrus smell | [40]       |
Adverse Side Effects and Antidotes of Antivenom Remedies

Most reports encountered on antivenom plants used in East Africa did not mention the side effects of herbal preparations from them when used in treating snake poisons. Nevertheless, herbal preparations from some plants (Cissampelos truncata, Lannea schweinfurthii, Lonchocarpus laxiflorus, Gardenia jovis-tonantis and Synaptolepis kirkii) were reported to induce violent vomiting [26, 35, 39]. This could be due to the improper posology, toxic phytochemicals or metabolic byproducts of the herbal remedies [114]. Indeed, most of the plants identified as used for treating snake poisons are purgatives or emetics. For example, the ching’ei tree (Euclea divinorum), Antidesma venosum, Cissampelos truncata, Lannea schweinfurthii, Senna singueana and Toddalia asiatica are some of the powerful purgatives known in East Africa [26, 39, 89, 95]. It should be emphasized that plant toxicity is important in initiating purgation and emesis which are regarded as the key treatment regimen for removal of snake poisons in East Africa [26, 39].

In some circumstances, antivenom remedies are prepared with other plants or with addition of non-plant materials. For example, Rhamnus prinoides root decoction is prepared with soup and taken [95]. This could act as an antidote for the side effects of this plant. Another plausible explanation could be that some side effects of the herbal remedies might be masked through the use of more than one plant (or plant parts). However, East African herbalists are known to use more than one plant or plant part as a strategy of keeping secret their actual herbal recipes [115].

Antisnake Venom Activities of Antiophidic Plants Reported in East Africa

To rationalize the antivenin activities of the 361 species identified, data from use reports were inadequate. We assessed scientific evidences in literature to hypothesize and discuss the potential scientific basis for the use of the identified plant species in antivenom therapy. Pharmacological effects of the identified species associated with specific activity against snake venoms were discussed. Most of the reported species (317, 87.8%) we retrieved have no published reports that robustly provide a scientific explanation for their use in treatment of snake poisoning. Only 44 species (12.2%) have been investigated for their inhibitory action against haemolytic, neurotoxic, creatine kinase isoenzyme, 5’ nucleotidase, phospholipase A2

| Family          | Genus and Species | Type       | Part(s)            | Preparation and Effect                                                                 | Reference |
|-----------------|-------------------|------------|--------------------|----------------------------------------------------------------------------------------|-----------|
| Annonaceae      | *Allium sativum* L.| Herb       | Bulb               | Decoction made and sprinkled around the house.                                           | [40]      |
|                 | *Annona chrysopylla* Bojer. | Shrub   | Stems, leaves      | Not reported                                                                            | [35]      |
|                 | *Annona senegalensis* Pers. | Tree    | Stem bark          | Not reported                                                                            | [35]      |
| Apocynaceae     | *Carissa spinarum* L. | Shrub     | Leaves             | Used as a repellent                                                                     | [52]      |
| Asparagaceae    | *Albuca abyssinica* Jacq. | Shrub     | Whole plant        | Planted as a snake repellent                                                            | [35]      |
|                 | *Sansevieria intermedia* N.E. Brown | Herb    | Leaves             | Sap used as bait to kill snakes                                                        | [70]      |
| Asteraceae      | *Tagetes minuta* L. | Herb      | Leaves             | Its bitter smell causes discomfort and disorientation to snakes when they slither over them | [40]      |
| Euphorbiaceae   | *Ricinus communis* L. | Herb      | Leaves, whole plant | Its strong smell causes discomfort and disorientation to snakes                          | [40]      |
| Fabaceae        | *Acacia macrothyrse* Harms | Tree     | Roots              | Put near the house                                                                      | [26]      |
| Poaceae         | *Cymbopogon citratus* (DC.) Stapf | Herb      | Leaves             | Decoction sprinkled around the house. Snakes are dissuaded by the citrus smell         | [40]      |
| Solanaceae      | *Nicotiana tabacum* L. | Shrub    | Leaves             | Grown in house vicinity or leaves burnt                                                  | [40]      |
(PLA2), lipoxygenase, hyaluronidase, acetyl cholinesterase and phosphodiesterase enzymes from snake venoms (Table 3). Antigen-antibody interaction is the suggested mechanism of action of venom antidotes. Venom inactivation occurs through precipitation, chelation, denaturing of toxic proteins, adjuvant action, venom enzyme inhibition, antioxidant action or a combination of these mechanisms [7]. *Combretum molle* had ten reports for both topical and internal use of its roots, leaves and root bark. Its aqueous and ethanolic leaf (folium) extracts had 28-113% inhibition of hyaluronidase, PLA2 and proteolytic activities of *N. nigricollis* and *B. arietans* venoms with median inhibitory concentration (IC$_{50}$) of 0.07 ± 0.02 mg/ml for aqueous extracts in anti-hyaluronidase activity inhibition of *N. nigricollis* venom [116]. Other commonly used plants in East Africa such as *Allium cepa*, *Annona senegalensis*, *Securidaca longipedunculata* and *Euphorbia tirucalli* have reports of antivenom activity which justifies their use in antisnake venom therapy (Table 3).

Table 3: Antivenom activities, toxicity and active phytochemicals of some plants used for snakebite treatment in East Africa

| Plant                  | Part used | Solvent | Antivenom activity and toxicity of extracts                                                                 | Reported chemical constituents                                                                 | Author(s) |
|------------------------|-----------|---------|-------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|-----------|
| *Acalypha fruticosa*   | Leaves    | Ethanol | Extracts inhibited Indian saw-scaled viper (*Echis carinatus*) venom-induced changes in haematological parameters for rats envenomed with 60 μL/mL of venom. Inhibitory activity (90%) against 5’Nucleotidase, phospholipase A2 (PLA2), hyaluronidase, acetyl cholinesterase and phosphodiesterase enzymes of *E. carinatus* venom tested at 1.25 mL with 50-400 μg of extract | Flavonoids, carbohydrates, cardiac glycosides, proteins, xanthoprotein, phenols, fatty acids, phlobatannins and emodins | [117, 118]|
| *Achyranthes aspera* L. | Stem      | Water   | Extracts significantly inhibited *Bitis arietans* venom PLA2 in an uncompetitive manner and stimulated protease activity i.e. the Michaelis Mentens and maximum velocity of *B. arietans* venom protease were significantly increased. | | |
|                        | Leaves    | Water, ethanol | Effectively neutralized Russel’s viper venom-induced lethality with a median lethal dose (LD$_{50}$) of 11 μg/μL with effective dose (ED$_{50}$) of 0.3 mg and 1.5 mg for aqueous and ethanolic extracts. PLA2 activity was neutralized at a dose of 0.05 mg and 0.06 mg for aqueous and ethanolic extracts, respectively. Neutralized venom-induced haemolysis in the range of 50-100 μg/μL. | | |
|                        | Leaves, stem | Methanol | A glycoside from it did not counteract the effects of *C. adamanteus* venom even at higher doses (2.4 mg/kg bw) | | |
|                        | Roots     | Methanol | No anti-haemorrhagic/anti-coagulant/anti-PLA2 activities against *Daboia russelli*, *Echis carinatus*, *Ophiophagus hannah* and *Naja kaouthia* venoms | | |
| *Aerva lanata*         | Leaves    | Acetone | Anti-PLA2 and anti-coagulant activities at 10 μL and 30 μL against *Naja naja* venom. The extract was able to inhibit four times the minimum coagulation dose with coagulation time of 238.0 ± 0.7 s | Triacontane, octacosane, heptacosane, tetradecane, docosane, heneicosane, 1,2-benzenedicarboxylic acid, Bis(2-methylpropyl) ester, heptadecane,9-hexyl-, Corynan-17-ol,18,19-didehydro-20-methoxy-, acetate (ester) | [123]   |
| Plant                  | Part used          | Solvent   | Antivenom activity and toxicity of extracts                                                                 | Reported chemical constituents                                      | Author(s)           |
|-----------------------|--------------------|-----------|------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|---------------------|
| *Allium cepa* L.      | Bulb               | Methanol  | Cardioprotective activity (14.8 ± 1.65 units/L) on creatine kinase isoenzyme levels to neutralize snake envenomation in experimental rabbits. Concentrations (< 160 μg/mL) stabilized human red blood corpuscles membrane (antihemolytic) against *N. naja karachiensis* venom, though elevated concentrations were cytotoxic. Provided 50% protection from *N. naja karachiensis* PLA2 in terms of an increase in pH of an egg yolk suspension. Neutralized the anticoagulant effect induced by weak PLA2 enzymes in *N. naja karachiensis* venom (76% inhibition, coagulation time of 106±0.57 s). Quercetin is a potent inhibitor of lipoygenase. | Quercetin (1), sulfurous volatile oils, oleic acid (2), protocatechuric acid (3) | [124-128]           |
| *Allium sativum* L.   | Bulb               | Methanol  | Hepatoprotective activity (49.00 ± 5.01 and 82.50 ± 18.55 units/L of aspartate aminotransferase and alanine aminotransferase against 52.50 ± 3.51 and 69.50 ± 18.55 units/L for standard antiserum) assessed in rabbits. Provided 50% protection from *N. naja karachiensis* PLA2 in terms of an increase in pH of an egg yolk suspension. Neutralized the anticoagulant effect induced by weak PLA2 enzymes in *N. naja karachiensis* venom (40% inhibition, coagulation time of 115±1.52 s). | Quercetin (1), scordinines A, B allicin, thiosulfates, 2 mercapto-L-cysteines, anthocyanins, allinase, polysaccharides, sativin I, sativin II, glycosides of kaempferol | [124, 126, 127]     |
| *Annona senegalensis* Pers. | Leaves, roots     | Methanol  | Extracts inhibited *Echis ocellatus* (Viper) venom activities. Root extract reduced hyperthermia and directly detoxified snake venom by 16–33% in rats against cobra (*N. nigricolis nigrilis*) venom. Extracts had IC<sub>50</sub> of 2.84± 3.90 mg/ml for hyaluronidase activity inhibition of *B. arietans* venom. Extract had LC<sub>50</sub> of 232.7 μg/ml in brine shrimp test. | Not reported          | [116, 129, 130]     |
| *Asystasia gangetica* L. | Leaves             | Methanol  | A concentration of 1000 mg/kg provided 80% protection against *N. melanoleuca* venom (PLA2) | Flavonoids, saponins and tannins                                   | [107]               |
| *Azima tetracantha* Lam. | Leaves             | Ethyl acetate | Extracts had significant inhibitory effect on phosphomonoesterase, phosphodiesterase, PLA2 and acetylcholinesterase enzymes from *Bungarus caeruleus* and *Vipera russelli* venoms in a dose dependent manner with concentrations ranging from 43.98 –340.1 μg/mL. Inhibited 5’ nucleotidase, phosphodiesterase and hyaluronidase activities of *B. caeruleus* venom completely at 100, 100 and 500 μg/ml with IC<sub>50</sub> of 55.9, 43.98 and 219.8 μg/mL, respectively. Inhibited acetylcholinesterase enzyme activity of *B. caeruleus* venom by 80% at 400 μg/mL with IC<sub>50</sub> of 219.8 μg/mL. | Flavonoids, phytosterols, proteins                                  | [131-133]           |
| *Azadirachta indica*  | Leaves             | Methanol  | Inhibited cobra venom (*Naja naja* and *Naja kaouthia*) and *Daboia russelli* venom PLA2 enzymes in a dose-dependent manner. Inhibited catalytic and other activities of cobra and Russell's viper venoms. Unidentified compound (AIPLAI) inhibited purified *N. kaouthia* PLA2 enzymes in a non-competitive manner. | Purified unidentified non-terpenoidal *A. indica* PLA2 inhibitor (AIPLAI) | [134-136]           |
| Plant | Part used | Solvent | Antivenom activity and toxicity of extracts | Reported chemical constituents | Author(s) |
|-------|-----------|---------|------------------------------------------|---------------------------------|-----------|
| *Balanites aegyptiaca* (L.) Del | Stem bark | Methanol | Extracts prolonged either the survival time(s) of mice, when injected immediately after the administration of *Naja arabica* and *B. arietans* venoms with LD$_{50}$ of 0.180, 1.25 and 0.40 mg/kg, or the clotting time of citrated blood plasma with each venom. | Saponins, tannins, terpenes, volatile oils, phytochemicals, glycosides, flavonoids, proteins, carbohydrates, steroids | [137, 138] |
| | Leafy branches, fruits | Acetone | Extracts afforded 100% protection against *E. carinatus* venom (with lethal dose of 0.194 mg/ml) administered intramuscularly to Wistar rats at 75 and 100 mg/ml | | |
| | | Water | Seed oil displayed significant inhibitory action against the lethal toxic and inflammatory effects of *V. russelli* venom (LD$_{50}$ of venom = 0.30 mg/kg). The ED$_{50}$ of the oil in both oil and venom pre-treated mice were 0.2 ml each, with Therapeutic Index of 1.75. | | |
| *Bidens pilosa* L. | Leaves | Water | Weakly antagonized the *Dendroaspis jamesoni* venom and did not potentiate antivenom lipse in Africa (SAY) | | [139] |
| *Calotropis procera* | Exudate, flowers | Methanol | Afforded 44% and 76% inhibition of *N. naja karachensis* venom PLA2 enzyme activity, respectively | Resins, tannins, calotropin, sterol, uscharin, calotropagenin, calotoxin, and calaxin | [124] |
| *Capparis tomentosa* Lam. | Radix | Water | Afforded 37-114% inhibition of hyaluronidase, PLA2 and proteolytic activities of *N. nigrincollis* and *B. arietans* venoms with IC$_{50}$ of 0.13 mg/ml for ethanolic extracts in anti-PLA2 activity of *B. arietans* venom | Not reported | [116] |
| *Carica papaya* L. | Cortex | Water | Caused -2 to 15% inhibition of hyaluronidase, PLA2 and proteolytic activities of *N. nigrincollis* and *B. arietans* venoms | Steroids, flavonoids, tannins, saponins, alkaloids, ursoic acid | [116] |
| *Carissa spinarum* L. | Leaves | Methanol | Activities of acetylcholinesterase, PL$A_2$, hyaluronidase, phosphomonoesterase, phosphodiesterase, 5- nucleotidase from *B. caeruleus* and *V. russelli* venoms were inhibited by 100 µg/ml of the extract | | [140] |
| *Cassia occidentalis* L. | Leaves, roots | Ethanol | Stimulated angiogenesis, inhibited epidermal hyperplasia, acted positively on wound healing progress and minimized local effects caused by *Bothrops moojeni* venom | Not reported | [141] |
| *Cissampelos mucronata* | Herba | Water | Had 2-120% inhibition of hyaluronidase, PLA2 and proteolytic activities of *N. nigrincollis* and *B. arietans* venoms with IC$_{50}$ of 0.15±0.02 mg/ml for aqueous extracts in anti-PLA2 activity of *N. nigrincollis* venom | | [116] |
| *Cissampelos pareira* L. | Aerial parts (leaves, flowers, tender stems), roots | Water | Ethanolic leaf extract (70%) was effective against anxiety-like behaviours. No anti-PLA2 activity for ethanolic root extract. Aerial parts neutralized proteolytic activity of *Bothrops diporus* venom. No inhibitory activity observed for aqueous leaf extracts against haemorrhagic and proteolytic activities from *Bothrops asper* venom. Ethanolic root extracts: Quercetin-3-O-sophoroside (5), naringenin 7-O-β-D-glucoside (6), eriodictyol-7-O-β-D-glucoside, galangin-7-glucoside (7) and baicalin-7-O-glucoside (or oxin A) (8) | | [142-145] |
| Plant                             | Part used  | Solvent       | Antivenom activity and toxicity of extracts                                                                 | Reported chemical constituents                                                                 | Author(s) |
|----------------------------------|------------|---------------|-------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|-----------|
| Citrus limon L. Burm. F          | Root, ripe fruits | Methanol     | Neutralized the coagulant effect induced by weak PLA2 enzymes in *N. naja karachiensis* venom (64% inhibition, coagulation time of 109±1.00 s). *In vitro* inhibitory activity reported against the lethal effect of Lachesis muta venom with ED₅₀ of 710 μg of extract per mouse. | d-α-pinene camphene, d-limonene, linalool (9), ichangin 4-β-glucopyranoside, nomilinic acid, 4-β-glucopyranoside | [127]     |
| Combreton molle                   | Folium     | Water, ethanol| 28-113% inhibition of hyaluronidase, PLA2 and proteolytic activities of *N. nigricollis* and *B. arietans* venoms with IC₅₀ of 0.07 ±0.02 mg/ml for aqueous extracts in anti-hyaluronidase activity inhibition of *N. nigricollis* venom. | Not reported                                                                                       | [116]     |
| Commiphora africana (A. Rich.) Engl. | Stem bark | Methanol     | Crude extract 200, 300 and 400 mg/kg incubated each with LD₉₀ (9.70 mg/kg) of the venom) protected treated mice from lethality of *N. nigricollis* venom while n-butane fraction at 200, 400 and 600 mg/kg offered 20%, 60% and 80% survival, respectively. Ethyl acetate, saponin-rich and flavonoid-rich fractions inhibited PLA2 activity of *N. nigricollis* venom with IC₅₀ values of 21.36, 26.47 and 17.52 μg/ml, respectively. | Not reported                                                                                       | [146, 147]|
| Cynodon dactylon                 | Roots      | Water         | Exhibited remarkable antihemolytic potential (94.3% to 90.6%) against crude *N. naja* venom at 200 to 1,500 μg/ml | 7αH,cyclopent[a]cycloprop[a][f]cyclohexene2,4,7a,1,0,1-ethox1,1a,2,3,4,4a,5,6,7,10,11-e-dodecyl hydro1,13,6,9-penta methyl,2,4,7,10,11-pentaacetate (a), α-D-Glucopyranoside,0-α-D-glucopyranosyl-(1.fwdarw.3)-α-D-fructofuranosy (b), 9-Octadecenoicacid(2-phenyl,3dioxolan4yl)methylene (c), 9,10-Secocholosta-5,7,10(19)-triene-1,3-diol,25-[(trimethylsilyl)oxy]-,(3a,5z,7E) (d),Octasiloxane,1,1,3,3,5,5,7,7,9,9,11,11,13,13,15,15-hexadecamethyl (e), 9-Oximino2,7-dioxygenene (f), Hexadecanoicacid-1-(hydroxymethyl)-2-ethanediylester (g), Hexadecoxilane,1,1,3,3,5,5,7,7,9,9,11,11-dodecamethyl (h), Heptasiloxane,1,1,3,3,5,5,7,7,9,9,11,11,13,13,13-tetradecamethyl (i), Estratriene1,3,5(10)-trien-17α-ol (j) | [148]     |
| Dicrrostachys cinerea L.          | Folium     | Water, ethanol| Provided -1% to 19% inhibition of hyaluronidase, PLA2 and proteolytic activities of *N. nigricollis* and *B. arietans* venoms with IC₅₀ of 0.09±0.02 mg/ml and, 0.26±0.04 | Not reported                                                                                       | [116]     |
| Plant                  | Part used          | Solvent          | Antivenom activity and toxicity of extracts                                                                 | Reported chemical constituents                                                                 | Author(s) |
|-----------------------|--------------------|------------------|------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|-----------|
| *Echinops amplexicaulis* Oliv. | Roots              | Not specified    | A novel crystalline caffeic acid from roots has antivenom agents for hemolytic snake venoms                  | Quercetin-3-O-rhamnoside (10), terpenoids, alkaloids, steroids, flavonoids, phenolics            | [149]     |
| *Euphorbia hirta* L.  | Whole plant        | Methanol         | LD$_{50}$ not specified against *N. naja* venom. Reduced PLA2 activity at 200 μM it by up to 96%          |                                                                                  | [150, 151]|
|                        | Leaves             | Ethanol          | LD$_{50}$ of extract is > 5000 mg/kg. Extracts (250 mg/kg bw) decreased clotting and bleeding times (from 1.40 ± 0.30 s to 1.20 ± 0.10 s and 1.90 ± 0.43 s to 0.90 ± 0.33 s) in mice envenomed with *N. nigricollis* venom (LD$_{50}$ = 1,414.21 μg/ml). Extract with that of *Portulaca oleracea* reduced clotting and bleeding times to 1.10 ± 0.10 s and 0.50 ± 0.23 s. Extract at 250 mg/kg bw afforded 100% survival of mice with 5- and 10-minute delay after venom administration |                                                                                  |           |
| *Gloriosa superba* L. | Tuber              | Methanol         | Protective activity against the lethal action of rattlesnake (*C. adamanteus*) venom administered to mice experimentally envenomed with 2.5–15 μg/kg bw of venom | Esters                                                                                       | [121]     |
| *Tephrosia purpurea*  | Roots              | Methanol         | Flavonoids fraction showed a moderate neutralizing effect of *C. adamanteus* venom                         |                                                                                  | [121]     |
| *Indigofera capitata* Forsk. | Whole plant    | Methanol, ethanol, water | Extracts reduced bleeding and clotting times in *N. nigricollis* envenomed rats. Ethanol and aqueous extracts were more effective at 300 mg/kg with lowest clotting time of 174.00 ± 3.67 s and 1000 mg/kg with lowest bleeding time of 228.00 ± 3.00 s. Oedema forming activity was inhibited by ethanol and aqueous extracts, effective at higher doses of 300 mg/kg (ethanol extract) and 1000 mg/kg (aqueous extract) with lowest oedema forming activity of 108.80 ± 1.90 and 102.00 ± 1.90% mm, respectively | Flavonoids, phenolics, steroids, triterpenes, anthraquinones, alkaloids | [152, 153]|
|                        | Petroleum ether, ethanol, water | | Extracts had LD$_{50}$ values of 774.6, 1131.4 and 3807.8 mg/kg, respectively. Dose-dependent oedema forming activity reported against *N. nigricollis* envenomed rats. Highest reduction in oedema forming activity of the extract were at 300 mg/kg (ethanol) and 1000 mg/kg (aqueous) with lowest edema forming activity of 108.00 ± 1.90 and 102.00 ± 1.90% mm, respectively |                                                                                  |           |
| *Jatropha carcus* L.  | Leaves (latex), seeds | Methanol, water, ethanol | Methanolic extract inhibited haemolytic activity of *N. naja* venom. Aqueous and ethanolic extracts had -10 to 21% inhibition of hyaluronidase, PLA2 and proteolytic activities of *N. nigricollis* and *B. arietans* venoms, respectively | Terpenoids, alkaloids, saponins                                                                 | [116, 154]|
| *Maesa lanceolata* Forsk. | Cortex             | Water, ethanol   | Provided 6-144% inhibition of hyaluronidase, PLA2 and proteolytic activities of *N. nigricollis* and *B. arietans* venoms with IC$_{50}$ of 0.11±0.01 mg/ml and 0.10±0.01 mg/ml for ethanolic extracts in anti-PLA2 and anti-hyaluronidase activities of *B. arietans* and *N. nigricollis* venoms, respectively | Not reported                                                                                  | [116]     |
| Plant                          | Part used | Solvent      | Antivenom activity and toxicity of extracts                                                                                                                                                                                                 | Reported chemical constituents                  | Author(s) |
|-------------------------------|-----------|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|------------|
| *Moringa oleifera* Lam        | Leaves    | Water, methanol | LD$_{50}$ of *N. nigricollis* and *B. arietans* venoms in albino rats were 1.0 and 1.5 mg/kg, respectively. The extracts ameliorated *B. arietans* venom-induced hypernatremia and hypercalcemia. Haemorrhagic, haemolytic and coagulating activities of the venoms were inhibited in a dose dependent manner by the extracts. Extracts effectively neutralized Russelli viper venom-induced lethality (LD$_{50}$ = 10.9 µg) at 10 µg/mice and 300 µg/mice (ED$_{50}$), respectively. Both extracts neutralized venom-induced haemolysis (50-100 µg). Inhibitory concentrations against PLA2 activity exhibited by aqueous and methanolic extracts were 0.06 mg and 0.07 mg, respectively. In procoagulant activity inhibition studies, the effective doses in neutralizing effect of Saw scaled viper venom was 1 µg for both extracts. | Saponins, alkaloids, tannins and flavonoids          | [155-157] |
| *Musa paradisiaca* L.         | Exudate/juice | Used directly | Exudate had no antivenom activity singly but mixing it with the venom (1:1) showed 100% inhibition of PLA2 activity of Bothrops jararacussu and Crotalus durissus terrificus venoms, as well as neutralized significantly the haemorrhagic activity induced by *B. jararacussu* venom. | Polyphenols and tannins                       | [158]      |
| *Paullinia pinnata* L.        | Root bark  | Water        | LD$_{50}$ of venom and extract were 1.5 and 1.200 mg/kg respectively. Extract at 400 mg/kg presented a weak antivenom activity against Carpet viper (*E. carinatus-ocelatus*) venom. Effective dose (ED$_{50}$) was estimated as 300 mg/kg (i.p) and > 400 mg/kg (p.o) in treated mice. | Carbohydrates, saponins, steroids and tannins | [159]      |
| *Portulaca oleracea* L.       | Leaves    | Ethanol, Water | LD$_{50}$ of extract was > 5000 mg/kg. Extracts (250 mg/kg bw) decreased clotting and bleeding times (from 2.20 ± 0.10 s to 1.40 ± 0.29 s and 1.90 ± 0.43s to 0.80 ± 0.18 s) in mice envenomed with *N. nigricollis* venom. Extract with that of *Euphorbia hirta* reduced clotting and bleeding times to 1.10 ± 0.10 s and 0.50 ± 0.23 s. Extract at 250 mg/kg bw afforded 100% and 80% survival of mice with 5- and 10-minute delay after venom administration. Anti-PLA2 activity showed that 1ml of 500 µg/ml of extract neutralized the toxic effects of 1ml of 200 µg/ml of *N. nigricollis* venom. | Carbohydrates, saponins, steroids and tannins | [160, 161] |
| *Pupalia lappacea* Juss       | Herba     | Water, ethanol | Provided 28-113% inhibition of hyaluronidase, PLA2 and proteolytic activities of *N. nigricollis* and *B. arietans* venoms with IC$_{50}$ of 0.10±0.07 mg/ml for aqueous extracts in anti-hyaluronidase activity inhibition of *N. nigricollis* venom. | Not reported                                   | [116]      |
| *Ricinus communis* L.         | Roots     | Methanol     | No anti-haemorrhagic/anti-coagulant/anti-PLA2 activities against *D. russelli, E. carinatus, O. hannah and N. kaouthia* venoms | Not reported                                   | [122]      |
| *Securidaca longipedunculata* Fresen | Root bark, leaves, roots | Water         | Root bark extract neutralized *N. nigricollis* Hallowell venom at 300 mg/kg bw with 100% survival. Leaf extract had lower antivenom activity with 33.3% mortality at 300 mg/ml. Combined root bark and leaf extracts afforded | Not reported                                   | [162, 163] |
| Plant                   | Part used         | Solvent   | Antivenom activity and toxicity of extracts                                                                 | Reported chemical constituents | Author(s) |
|------------------------|-------------------|-----------|---------------------------------------------------------------------------------------------------------------|-------------------------------|------------|
| Securinega virosa (Roxb.) Baill. | Leaves            | Hexane, ethyl acetate, methanol | Hexane extract provided protection against lethal dose of *N. nigricollis* venom (significant at 20 mg/kg). Afforded -29% to 127% inhibition of hyaluronidase, PLA2 and proteolytic activities of *N. nigricollis* and *B. arietans* venoms with IC50 of 0.17±0.01 mg/ml and 0.13±0.00 mg/ml for ethanolic extracts in anti-PLA2 and anti-hyaluronidase activities of *B. arietans* and *N. nigricollis* venoms, respectively. | Not reported                  | [116, 164] |
| Strychnos innocua Delile | Folium            | Water, ethanol | Afforded 28-113% inhibition of hyaluronidase, PLA2 and proteolytic activities of *N. nigricollis* and *B. arietans* venoms with IC50 of 0.10±0.07 mg/ml for aqueous extracts in anti-hyaluronidase activity inhibition of *N. nigricollis* venom | Not reported                  | [116]      |
| Strychnos spinosa Lam. | Radix             | Water, ethanol | Exhibited -1% to 29% inhibition of hyaluronidase, PLA2 and proteolytic activities of *N. nigricollis* and *B. arietans* venoms | Not reported                  | [116]      |
| Tamarindus indica L.   | Seeds             | Ethanol, water | Extract inhibited PLA2, protease, hyaluronidase, L-amino acid oxidase and 5'-nucleotidase enzyme activities of *V. russelli* venom in a dose-dependent manner | Not reported                  | [116, 165, 166] |
| Xeromphis nilotica (Stapf) Keay | Stem bark        | Water | Extract had LD50 of 1000 mg/kg. LD50 of *N. haje, N. katiensis, N. nigricollis, E. ocellatus* and *B. arietans* venoms in Wistar rats were 0.22, 0.55, 0.87, 1.24 and 1.80 mg/kg, respectively. Extracts afforded 100% and 85.7% protection against *N. nigricollis, N. haje, N. katiensis, E. ocellatus* and *B. arietans* venom, respectively. | Carbohydrates, glycosides, steroids/triterpenes, cardiac glycosides, saponins, glycosides and alkaloids | [167]      |
| Zanthoxylum chalybeum Engl. | Roots            | Water | Silver nanoparticles synthesized using the extracts inhibited digestion of albumin by *B. arietans* venom with 100% inhibition of proteolytic activity achieved with 3.28 mg/L of silver nanoparticles | Not reported                  | [12]       |
| Ziziphus mucronata Wild | Radix             | Water, ethanol | Afforded 82-137% inhibition of hyaluronidase, PLA2 and proteolytic activities of *N. nigricollis* and *B. arietans* venoms with IC50 of 0.30±0.02 mg/ml for ethanol extracts in anti-hyaluronidase activity of *N. nigricollis* venom | Not reported                  | [116]      |

i.p: intraperitoneally, p.o: per os (by mouth)

The most used plant (*Solanum incanum*) had no report of antivenom activity. Another member of this family (*Nicotiana tabacum*) had two use reports of its leaves and roots for both topical application and internal use. *N. tabacum* is a recreational herb whose effects was established to be due to the presence of the alkaloid: 3-(1-methyl-2-pyrrolindyl) pyridine (nicotine) [168].
The alkaloid is known to regulate cholinergic neurotransmission by interacting with nicotinic acetylcholine receptors (nAChRs) and was previously reported to possess neuroprotective potential [169]. Venoms such as α-cobrotoxin reported in cobras (Naja species) are neurotoxic because they inhibit nAChRs [170]. It is against this background that oral administration of *N. tabacum* in treating snake poisons may have a rationale because nicotine has anti-nAChR effects that could explain its ability to neutralize anti-cholinergic effects of snake venoms. In addition, the antivenom venom activity of some of the plants identified could be mediated through their antioxidant, anti-allergic, analgesic, anti-inflammatory, anti-pyretic, anti-anxiety and anti-anaphylactic activities [171]. For example, via antioxidation, plant secondary metabolites antagonize oxidative damage by PLA2 through selective binding to the enzyme active sites or modifying the conserved residues required for PLA2 catalytic activities [172].

![Figure 5: Some of the molecules characterized from extracts of antisnake venom plants reported in East Africa. The numbers 1-10 refers to the molecules mentioned in Table 3](image)

The secondary metabolites responsible for plant antivenom activities have been identified to be majorly flavonoids, terpenoids, alkaloids, steroids, tannins and phenolics. Of these, flavonoid compounds such as quercitrin, quercetin (1), quercetin-3-O-rhamnolside (9) (Figure 5) have been reported to possess significant inhibitory activity against PLA2.
enzymes from snake venoms [173-175] with 42% and 96% inhibition at 200 μM, respectively [150, 176]. Higher PLA2 inhibitory activities of quercetin glycosides has been ascribed to the presence of the sugar moiety [150, 175]. Quercetin glycosides interact with Gly30, Gly32, His48 and Asp49 residues in the substrate binding site of PLA2, affording inhibition of its activities [175]. Further, molecular docking studies has reported that these inhibitory activities are due to the formation of hydrogen bonds, polar interactions and hydrophobic interactions, which suggested that other flavonoids with analogous structures to that of quercetin and quercetin-3-O-rhamnoside could be potential PLA2 inhibitors [176].

It is important to note that antivenom efficacy of plant extracts is contingent on the extraction solvent employed. Methanol and ethanol have been the solvents of choice in most studies, probably due to their ability to dissolve both polar and organic phytochemicals [7]. Though some studies used water as the solvent of extraction, organic extracts tended to exhibit higher antivenom activities than the aqueous extracts. A recent study [12] highlighted that silver nanoparticles from aqueous root extracts of Zanthoxylum chalybeum completely inhibited the proteolytic activities of B. arietans venom at 3.28 mg/L of silver nanoparticles. This provides an insight into a theme that could be further explored as nanoparticles have increasingly become of interest in the management of various diseases.

Conclusion
In this work, we retrieved 361 plant species reported as traditional therapies for snakebites in East Africa. The study also identified distinct cases of doctrine of signatures and zoopharmacognosy in snakes using Opilia amentacea, Hugonia castaneifolia and Microglossa pyriformia which could be further explored. Only 44 species (12.2%) of the 361 identified species have been evaluated globally for their antivenom activity, with most species found to be effective in reversing the lethal actions of snake venoms. Future studies are required to assess the efficacy of the claimed unstudied species and their active phytoconstituents. Emphasis should be put on the conservation and cultivation of antivenom plants with high use frequency.

Abbreviations
C. adamanteus: Crotalus adamanteus, IC₅₀: Half maximal concentration; LD₅₀: Median lethal dose, LD₉₀: Minimum lethal dose, N. naja: Naja naja, PLA2: phospholipase A₂, V. russelli: Viper russelli.

Competing interests
The authors declare that there is no conflict of interest regarding the publication of this paper.

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Conflict of Interest
We have no conflicts of interest to disclose.

References
[1]. Tomaz M.A., Patrião-Neto F.C., Melo P.A., Plant Toxins, 2016, 1
[2]. Launch of WHO’s global strategy for control and prevention of snakebite envenoming. World Health Organization, Genenva, Switzerland. WHO, 2019, Available from https://www.who.int/news-room/events/launch-of-the-global-strategy-for-snakebite-prevention-and-control
[3]. Williams D., Gutierrez J.M., Harrison R., Warrell D.A., White J., Winkel K.D., Gopalakrishnakone P., Lancet, 2010, 375:89
[4]. Gutierrez J.M., Williams D., Fan H.W., Warrell D., Toxicol, 2010, 56:1223
[5]. Warrell D.A., Gutiérrez J.M., Calvete J.J., Williams D., Indian J. Med. Res., 2013, 138:38
[6]. Gómez-Betancur I., Gogineni V., Salazar-Ospina A., León, Molecules F., 2019, 24:3276
[7] Omara T., Kagoya S., Odeny A., Onnute T., Ssebulime S., Kiplagat K.M., Bongomin O., *Trop. Med. Health*, 2020, **48**:6

[8] Omara T., *J. Toxicol.*, 2020, **2020**:1828521

[9] Harrison R.A., Oluoch G.O., Ainsworth S., Alsolaiss J., Bolton F., Arias A.S., Gutiérrez J.M., Rowley P., Kalya S., Ozwara H., Casewell N.R., *PLoS Negl. Trop. Dis.*, 2017, **11**(e0005969)

[10] Okumu M.O., Patel M.N., Bhogayata F.R., Occhola F.O., Olweny I.A., Onono J.O., Gikunju J.K., *FI000Res.*, 2019, **1**:1588

[11] Nishijima C.M., Rodrigues C.M., Silva M.A., Lopes-Ferreira M., Vilegas W., Hiruma-Lima C.A., *Molecules*, 2009, **14**:1072

[12] Mahamadi C., Wunganayi T., *Cogent Chem.*, 2018, **4**:1538547

[13] Medecins Sans Frontiers. Snakebite in South Sudan: little hope of a cure for the most vulnerable. 2014, Available: https://www.msfaccess.org/snakebite-south-sudan-little-hope-cure-most-vulnerable

[14] Occhola F.O., Okumu M.O., Muchemi G.M., Mbaria J.M., Gikunju J.K., *Pan Afr. Med. J.*, 2018, **29**:217

[15] Wangoda R., Waton B., Kisige M., East Central Afr. J. Surg., 2004, **9**:1

[16] Devi C.M., Bai M.V., Lal A.V., Umashankar P.R., Krishnan L.K., *J. Biochem. Biophys. Method.*, 2002, **51**:129

[17] Chintamunnee V., Mahomoodally M.F., *J. Herbal Med.*, 2012, **2**:113

[18] WHO Global Report on Traditional and Complementary Medicine, 2019. Accessed 04 Mar 2020, Available: https://www.who.int/traditional-complementary-integrative-medicine/WhoGlobalReportOnTraditionalAndComplementaryMedicine2019.pdf?ua=1

[19] Gurib-Fakim A., *Mol. Aspect. Med.*, 2006, **27**:1

[20] Mahomoodally M.F., *Evid. Based Complement. Alternat. Med.*, 2013, **2013**:617459

[21] Ntume R., Anywar U.G., *Curr. Life Sci.*, 2015, **1**:6

[22] Sharma A.,Flores-Vallejo R.D.C., Cardoso-Taketa A., Villarreal M.L., *J. Ethnopharmacol.*, 2017, **208**:264

[23] Bally P.R.O., *Bull. Misc. Inform.*, 1937, **1937**:10

[24] Tabuti J.R.S., Dhillion S.S., Lye K.A., *J. Ethnopharmacol.*, 2003, **88**:19

[25] Jeruto P., Lukhoba C., Ouma G., Otieno D., Mutai C., *Afr. J. Tradit. Complement. Altern. Med.*, 2007, **5**:103

[26] Kokwaro J.O., *Medicinal plants of East Africa*. 2nd Edn. East African Literature Bureau, Nairobi, Kenya, 1993

[27] Jeruto P., Mutai C., Ouma G., Lukhoba C., Nyamaka R.L., Manani S.D., *J. Anim. Plant. Sci.*, 2010, **8**:1016

[28] Kikotz Z., *Livelihoods and Ecosystem Services around Protected Areas, A case study from Ugalla Ecosystem, Tabora, Tanzania. University of Klagenfurt, Austria, M.Sc. thesis, 2009

[29] The New Vision. How to avoid gangrene from a snake bite. 2007, Accessed 03 Mar 2020, https://www.newvision.co.ug/news/1168227/avoid-gangrene-snake-bite

[30] Owuor B.O., Kisangau D.P., *J. Ethnobiol. Ethnomedicin*, 2006, **2**:7

[31] Owuor B.O., Mulemi B.A., Kokwaro J.O., *J. Ethnobiol.*, 2005, **20**:129

[32] Hamisy W.C., Mwaseba D., Zilihona I.E., Mwihomeke S.T., *Status and Domestication Potential of Medicinal Plants in the Uluguru Mountain Area, Tanzania*. Wildlife Conservation Society of Tanzania (WCST), 2000

[33] Maregesi S., Kagashe G., Masatu K., Schol. Acad. J. Pharm., 2013, **2**:381

[34] Watt J.M., Breyer-Brandwijk M.G., *The Medicinal and Poisonous plants of Southern and Eastern Africa*. Edinburgh & London E.S. Livingstone Ltd, 1962

[35] Okot D.F., Anywar G., Namukobe J., Byamukama R., *Trop. Med. Health*, 2020, **48**:44

[36] Oryema C., Bukenya Ziraba R., Omagor N., Opio A., *Afr. J. Ecol.*, 2010, **48**:285

[37] Tugume P., Kakudidi E.K., Buyinza M., Namaalwa J., Kamatenesi M., Mucunguzi P., Kalema J., *J. Ethnobiol. Ethnomed.*, 2016, **12**:5

[38] Gumisiriza H., Birungi G., Olet E.A., Sesaaa C.D., *J. Ethnopharmacol.*, 2019, **239**:111926

[39] Wanzala W., Syombua S.M., Alwala J.O., *Indian J. Ethnopharmac.*, 2016, **2**:46

[40] Daily Monitor, Using nature to get rid of snakes and their venom. Accessed 15 Aug 2020, https://www.monitor.co.ug/Magazines/HealthLiving/Using-nature-to-get-rid-of-snakes-and-their-venom/689846-2852038-78tpn/index.html

[41] Mbuni Y.M., Wamg S., Mwangi B.N., Mbari N.J., Musili P.M., Walter N.O., Hu G., Zhou Y., Wang Q., *Plants*, 2020, **9**:331

[42] Hedberg I., Hedberg O., Madati P.J., Mshigeni K.E., Mshiwi E.N., Samuelsson G., *J. Ethnopharmacol.*, 1982, **6**:29

[43] Chhabra S.C., Mahunna R.L.A., Mshiwi E.N., *J. Ethnopharmacol.*, 1987, **21**:253

[44] Kareru P.G., Kenji G.M., Gachanja A.N., Keriko J.M., Mungai G., *Afr. J. Tradit. Complement. Altern. Med.*, 2007, **4**:75
[45]. Odongo S.O., Medicinal plants of chuka community inthuraka nithi county, kenya and some of their selecteelemental, MSc Thesis, Kenyatta University, Nairobi, Kenya, 2013

[46]. Muriuki J., Medicinal trees in smallholder agroforestry systems: assessing some factors influencingcultivation by farmers East of Mt Kenya, PhD Dissertation, University of Natural Resources andApplied Life Sciences, Vienna, Austria, 2011

[47]. The Kamba Creation Story and Origin of Death. Accessed 03 Mar 2020, https://lostmythologies.com/the-kamba-creation-story-and-origin-of-death/

[48]. Kikwero J.O., Medicinal Plants of East Africa. EastAfrica Education Publishers, Nairobi, Kenya, 1994

[49]. Kigen G., Kipkore W., Wanjohi B., Haruki B., J. Kemboi, PharmacoG. Res., 2017, 9:333

[50]. Ministry of Natural Resources and Tourism Forestry And Beekeeping Division. The Role of Non Wood ForestProducts In Food Security And Income Generation. Support to formulation of national forest programme–Tanzania, 2000, 67

[51]. Kodi P., Mwangi M.E., Kiplagat C.P., Karuki T.S., Eur. J. Med. Plant., 2017, 21:1

[52]. Maundu P., Teng’eas B., Birnie A., Muema N.,Useful trees and shrubs for Kenya, 2nd ed. WorldAgroforestry Centre, 2005

[53]. Weiss E.A., Econ. Bot., 1979, 33:35.

[54]. Doka I.G., Yagi S.M., Ethnobot. Leaf, 2009, 13:1409

[55]. Issa T.O., Mohamed Y.S., Yagi S., Ahmed R.H.,Najeeb T.M., Makhawi A.M., Khider T.O., J. Ethnobiol. Ethnomed., 2018, 14:31

[56]. Okello J., Ssegawa P., Afr. J. Ecol., 2007, 45:76

[57]. Kamatenesi M.M., Acipa A., Oryem-Origa H., J.Ethnobiol. Ethnomed., 2011, 7:7

[58]. Mutwiwa C., Rotich B., Kauti M., J. Rithaa, J. Dis. Med. Plants., 2018, 4:110

[59]. Namukobe J., Kasene J.M., Kiremire B.T.,Byamukama R., Kamatenesi-Mugisha M., Krief S.,Dumontet V., Kabasa J.D., J. Ethnopharmacol., 2011,136:236

[60]. Chhabra S.C., Mahunna Mahunna R.L.A., Mshiu E.N., J. Ethnopharmacol., 1989, 25:339

[61]. Odongo E., Mungai N., Mutai P., Karumi E.,Mwangi J., J. Omale, Appl. Med. Res., 2018, 4:22

[62]. Hamill F.A., Apio S., Mubiru N.K., Mosango M.,Bukenya-Ziraba R., Maganyi O.W., Soejarto D.D., J.Ethnopharmacol., 2000, 70:281

[63]. Hines D.A., Eckman K., Indigenous MultipurposeTrees of Tanzania: Uses and Economic Benefits for O.D.People. FO:Misc/93/9 Working paper. Food andAgriculture Organization of the United Nations. Rome,August 1993

[64]. Haerdi F., Acta Tropica, Suppl., 1964, 8:1

[65]. Bosch C.H., In: Schmelzer, G.H. & Gurib-Fakim, A. (Eds), PROTA Wageningen, Netherland, 2006,Accessed 25 Aug 2020, https://www.prota4u.org/database/protav8.asp?g=pe&p=T richodesmus+zeylanicum+(Burm.f.)+R.Br

[66]. Kigen G., Kamuren Z., Njiru E., Wanjohi B.,Kipkore W., Evid. Based Complement. Altern. Med.,2019, 2019:897693

[67]. Kamau L.N., Mbaabu P.M., Mbaria J.M., GathumbiP.K., Kiama S.G., Tang, 2016, 6:e21

[68]. Mottel N.P., In: Schmelzer, G.H. & Gurib-Fakim,A. (Editors). PROTA, Wageningen, Netherland, 2013,Accessed 06 March 2020 https://uses.plantnet-project.org/en/Maerua_triphylla_(PROTA)

[69]. Prota4U, Combretum padoides Eng. & Diels,Accessed 04 Apr 2020, https://www.prota4u.org/database/protav8.asp?g=pe&p=Combretum+padoides+Engl.+&+Diels

[70]. Kipkore W., Wanjohi B., Rono H., Kigen G., J.Ethnobiol. Ethnomed., 2014, 10:24

[71]. Okello S.V., Nyunja R.O., Netondo G.W., OnyangoJ.C., Afr. J. Tradit. Complement. Altern. Med., 2010,7:1

[72]. Kigen G., Some F., Kibosia J., Rono H., Kiprop E.,Wanjohi B., Kigen P., Kipkore W., J. Biodivers. Biopros. Dev., 2014, 1:1

[73]. Nanbeja C., Tugume P., Nyakoocj C., Kamatenesi-Mugisha M., Ethnobot. Res. Appl., 2019, 18:1

[74]. Augustino S., Gillah P.R., Int. Forest Rev., 2005,7:44

[75]. Chhabra S.C., Mahunna Mahunna R.L.A., Mshiu E.N., J.Ethnopharmacol., 1990, 28:255

[76]. Musa M.S., Abdelrasoool F.E., Elshevik E.A.,Ahmed L.A.M.N., Mahmoud A.L.E., Yagi S.M., J. Med.Plant Res., 2011, 5:287

[77]. Chhabra S.C., Mahunna Mahunna R.L.A., Mshiu E.N., J. Ethnopharmacol., 1990, 29:295

[78]. Hedberg I., Hedberg O., Madati P., Mshigeni K.E.,Mshiun E.N., Samuelsson G., J. Ethnopharmacol., 1983,9:105

[79]. Kaigong M.M., Musila F.M., Int. J. Ethnobiol. Ethnomed., 2015, 1:1

[80]. Mutie F.M., Gao L.L., Kathambi V., Rono P.C.,Musili P.M., Ngugi G., Hu G.W., Wang Q.F., Evid. basedComplement. Alternat. Med., 2020, 2020:1543831

[81]. Rufford, Ethnomedicine of Tugen Community, Baringo County- Kenya, 2020, Accessed 20 Mar 2020,https://www.rufford.org/files/19802-1%20Medicinal%20Plants%20of%20Baringo%20Kenya.pdf.

[82]. Ramathal D.C., Ngassapa O.D., Pharmaceut. Biol.,2001, 39:132
[167]. Yunusa Y., Development of a deep convolutional neural network-based system for object recognition in visible light and infrared images, PhD Thesis, Ahmadu Bello University, Zaria, Nigeria, 2017
[168]. Omara T., Musau B., Kagoya S., Am. J. Heterocycl. Chem., 2018, 4(4), 107-144
[169]. Howes M.J.R., Natural Products, Springer, 2013
[170]. Alama A., Bruzzo C., Cavalieri Z., Forlani A., Utkin Y., Casciano I., Romani M., PLoS One., 2011, 6:e20695
[171]. Giovannini P., Howes M.J.R., J. Ethnopharmacol., 2017, 199:240
[172]. Leanpolchareanchai J., Pithayanukul P., Bavovada R., Saparpakorn P., Molecules, 2009, 14:1404
[173]. Lindahl M., Tagesson C., Inflammation, 1993, 17:573
[174]. Lättig J., Böhl M., Fischer P., Tischer S., Tietböhl C., Menschikowski M., Gutzeit H.O., Metz P., Pisabarro M.T., J. Comput. Aided Mol. Des., 2007, 21:473
[175]. Toyama O., Gaeta H.H., de Pinho M.V., Ferreira M.J., Romoff P., Matioli F.F., Magro A.J., Fontes M.R., Toyama M.H., Biomed. Res. Int., 2014, 2014:341270
[176]. Cotrim C.A., de Oliveira S.C., Diz Filho E.B., Fonseca F.V., Baldissera Jr L., Antunes E., Ximenes R.M., Monteiro H.S., Rabello M.M., Hernandes M.Z., de Oliveira Toyama D., Toyama M.H., Chem. Biol. Interact., 2011, 186:9
[177]. Omara T., Kiprop A.K., Ramkat R.C., Cherutoi J., Kagoya S., Nyangena D.M., Tebo T.A., Neziyaremye P., Karanja L.N., Jepchirchir A., Maiyo A., Kiptui B.J., Mbabazi I., Nakiguli C.K., Nakabuye B.V., Kosce M.C., Evid. Based Complement Alternat Med., 2020, 2020:3529081

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