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Review Article

# ETHNOMEDICINAL USES IN SCORPION POISONING (*GONUSU VISHA*) IN SRI LANKAN TRADITIONAL MEDICINE

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**ABSTRACT**

Scorpions use their sting as a defensive weapon or as a mechanism to incapacitate prey. The scorpion sting possesses venom and the character of the poison depends on the scorpion species. Some may lead to death. Ayurveda and Sri Lankan traditional physicians treat scorpion sting by administering medicines internally and externally, in various forms. Data was gathered from Ayurveda and Sri Lankan traditional medical books, through interviewing physicians, research journals and internet. Herbs, minerals and animal sources are used to treat scorpion sting. Analgesic, anti-inflammatory, antihistaminic, antipyretic, antispasmodic, antioxidant, cardioproective, respiratory protective, neuroprotective properties and anti-scorpion venom activity of these ingredients are scientifically proven. Due to these properties, these ingredients are capable of overcoming the symptoms such as pain, swelling, redness, itching, spasms, neurotoxicity and also cardiac and respiratory failure occurring through scorpion sting. It is concluded that Ayurveda and Sri Lankan traditional physicians possess multi-faceted, effective treatment methods for scorpion stings which can be scientifically proven.

**KEYWORDS:** Scorpion poisoning, *Gonusu Visha*, Ethnomedicinal uses, Sri Lanka.

## INTRODUCTION

Scorpions are eight-legged carnivorous anthropoids that are found worldwide. They are mainly found in the southern hemisphere in deserts and jungle habitats alike. [1] Scorpions are generally nocturnal, meaning that they spend the day under rocks and in crevices and then come out to hunt in the safety of darkness.

There are many species of scorpions' worldwide. Fet *et al*., (2000) list 16 families, 154 genera, and 1252 species of extant scorpions. While the number of families is now revised to 17 families, and it is acknowledged that this number will likely increase over the next few years as the research at the suprageneric level continues. Seventeen families of scorpion are Buthidae, Microcharmidae, Pseudochactidae, Chaerlidae, Chactidae, Euscorpiidae, Scorpiopidae, Superstitioniidae, Troglotayosicidae, Iuridae, Vaejovidae, Bothriuridae, Ischnuridae, Heteroscopionidae, Urodacidae, Diplocentridae and Scorpionida. [2]

Sri Lanka is home for 18 scorpions under 3 families. Whilst all scorpions are venomous, only one species native to Sri Lanka is fatal to humans.[3] *Buthoscorpio sarasinorum, Charmus laneaus, Isometrus basilicus, Isometrus besucheti, Isometrus garyi, Isometrus loebli, Isometrus thwaitesi, Lychas ceylonensis* and *Lychas srilankanensis* belonging to the family Buthidae, are endemic to Sri Lanka.[3] *Chaerilus ceylonensis* belongs to the family Chaerilidae and *Heterometrus gravimanus* belongs to the family Scorpionidae are also endemic to Sri Lanka.[3] *Hottentotta tamulu, Isometrus acanthuru, Isometrus maculates* and *Isometrus thurstoni* belonging to the family Buthidae, and *Heterometrus indus, Heterometrus spinifer and Heterometrus swammerdami* belongs to the family Scorpionidae are nonendemic to Sri Lanka.[3] *Hottentotta tamulus* is the only dangerously venomous scorpion in Sri Lanka. However, globally around 50 scorpion species are thought to carry enough venom that could cause more serious harm to humans and around half of those 50 scorpion species are believed to be capable of causing fatal results when having stung a human being.[1]

Scorpion poisoning is known as *Vrishchika Visha* in Ayurveda medicine and *Gonusu Visha* in Sri Lankan Traditional medicine. Sushruta describes three types of scorpions based on poison; that is *Manda Visha* (mildly poisonous), *Madhya Visha* (moderately poisonous) and *Maha Visha* (virulently poisonous).[4] Mild, moderate and virulent scorpion species are twelve, three and fifteen in number respectively and total number is thirty.[4] Mildly poisonous scorpions are originated from putrefied cow dung. Those who originated from wood and bricks have moderate poison and those originated from sloughed snake or other poisonous substances are of virulent nature.[4]

According to Sushruta, sting of mildly poisoning scorpion produces pain, trembling, stiffness in body and out flow of black blood. If stung in extremities, pain rushes upwards along with burning sensation, sweating, local inflammatory swelling and fever.[4] Moderately poisoning scorpion produces disorders similar to that of snakes, which they are born of. Further, inflammation of tongue, obstruction of swallowing food and severe fainting may present due to sting from moderately poisoning scorpion.[4] With virulently poisoning scorpion sting, the symptoms of snake poisoning emerges, eruptive boils appear with giddiness, burning sensation, fever and virulent discharge of black blood from the passages may present which leads to death of the patient.[4]

Scorpion sting cases can be categorized into two general types: those involving localized, transitory symptoms usually lasting from few minutes to several hours, and those involving systemic reactions. [2]

Localized responses are characterized by immediate pain followed by moderate swelling at the sting site. In some cases, the sting may result in a raised, reddened, indurated lesion, even in the case of relatively harmless scorpions (e.g. *Vaejovis carolinianus*).

In cases involving cytolytic toxins (e.g. scorpionids and ischnurids) swelling may persist up to 72hr, followed by development of haemorrhages and blood-filled blisters near the sting site. Sloughing of skin may occur, but this varies greatly in severity.

Other localized effects include gooseflesh, sweating, and muscle spasm near the sting site.

In case of stings, pain usually radiates from the site of the sting up the affected limb. The pain tends to concentrate in the joint, especially the armpits and groin, and often crosses from one armpit to another.

In the case of systemic reactions, clinical signs and symptoms are highly variable, ranging from mild to life threatening. Systemic reactions commonly are mild and are not necessarily indicators of a serious problem. Often there is no appreciable swelling or discoloration of the sting site. An intense aching and burning sensation may spread to adjacent tissues, which in turn often throb, sometimes becoming numb. The acute pain at the sting site turns into a chronic dull pain accompanied by a feeling of numbness around the edge of the sting site, which may persist for one to several days. Numbness in the face, mouth, and throat is fairly common. Muscles may become spasmodic, resulting in muscular twitching, slurred speech, difficulty swallowing, tightness or cramps in the chest and back, rapid heartbeat, and nausea. Often these systemic responses persist less than an hour after the sting and are not considered as serious.[2]

In more severe systemic reactions, neurological effects can lead to profuse sweating and salivation, restlessness, extreme nervousness, respiratory and cardiovascular problems, mental confusion, and convulsions. As the clinical symptom indicates, the principle components of the venom of dangerous scorpions are neurotoxins.

**Neurotoxins mechanism**

These toxins act on autonomic, sympathetic, and neuro-muscular systems, causing the wide range of systemic reactions reported in sting victims.

They act by disrupting voltage-sensitive sodium and potassium channels of nerves, which in turn causes neural depolarization, prolonged action potentials, repetitive firing, and uncontrolled release of vasodilators and neurotransmitters, which affect virtually every major organ system.

The effects on neurotransmitters result in a depletive release of catecholamines (e.g., adrenaline, noradrenaline) that severely damages the heart and other organs. The most commonly reported cause of death in scorpion sting cases is cardiac failure. In other cases, respiratory failure maybe the cause, especially in patients with upper respiratory infections or related problems. Death usually occurs several days after envenomation. If symptoms subside during the first 2-12 hr following a sting, the prognosis for recovery is generally good. Mortality rates are quite variable, depending on the species and amount of venom injected.

Scorpion venom is a very complex mixture of substances which differs significantly among various taxa, within families, and among genera. Differences also occur in different geographic populations of the same species and even within the same populations. The toxins are low-molecular weight proteins which are among the most powerful toxin known. They are

comparable in some species to the neurotoxins of certain deadly snakes.

Two recognized types of neurotoxins are;

- α- scorpion toxin, characteristic of the genera *Androctonus, Leiurus,* and *Buthus.*
- β- scorpion toxin, characteristic of *Centruroides.*[2]

The effect of envenomation by any given scorpion species can differ significantly among individual cases, owing to wide range of contributing factors.[5]

Sri Lankan traditional medicine and Ayurveda describe various medicines to neutralize these toxins. Aim of the study is to collect Sri Lankan traditional medicines which are used in treatment of scorpion sting.

## MATERIAL AND METHODS

Sri Lankan traditional physicians treat scorpion bites successfully. Treatments used in scorpion bites were gathered from Ayurveda and Sri Lankan traditional medical books, interviewing physicians, research journals and internet.

## RESULTS

Ayurveda and Sri Lankan traditional medicine prescribe various medicines internally and externally.

### a) Oral administration

1. Cow's milk mixed with ghee or sugar cane jaggery should be given orally to reduce scorpion poisoning.[4,6]
2. Jaggery dissolved in cold water and mixed with *Chaturjata* (stem bark of *Cinnamomum zeylanicum*, leaves of *Cinnamomum tamala*, seeds of *Elettaria cardamomum* and stamens of *Mesua ferrea* flowers) should be drunk for scorpion bites.[4]
3. Juice extracted from fresh leaves of *Jasminum officinale* (Family: Oleacae; Sinhala name: *Da Saman*) is mixed with ghee and given to drink in scorpion sting.[6,7]
4. Juice extracted from fresh leaves of *Fluggea leucopyrus* (Family: Celastraceae; Sinhala name: *Katupila*) is mixed with cane sugar and given to drink in scorpion sting.[7]
5. Juice extracted from entire plant of *Amaranthus viridis* (Family: Amaranthaceae; Sinhala name: *Koora Thampala*) is mixed with cane sugar and given to drink in scorpion sting.[7]
6. Rock salt is mixed with ghee and given to drink in scorpion sting.[7]
7. Thirty grams (6 Kalan) roots of *Toddalia asiatica* (Family: Rutaceae; Sinhala name: *Kudumirissa*) and *Gmelina arborea* (Family: Verbenaceae; Sinhala name: Eth Demata) are mixed with 1920 ml of water and boiled down to 240ml. 120 ml of this decoction is mixed with sugar and given twice a day with sugar.[8]
8. Thirty grams (6 Kalan) roots of *Toddalia asiatica* (Family: Rutaceae; Sinhala name: *Kudumirissa*) and *Gmelina arborea* (Family: Verbenaceae; Sinhala name: *Eth Demata*) are mixed with 1920 ml of water and boiled down to 240ml. 120 ml of this decoction is mixed with sugar and given twice a day with sugar.[8]
9. *Panchangaya* (root, stem, leaves, flowers, pods) of *Cassia auriculata* (Family: Fabaceae; Sinhala name: *Ranawara*) are mixed with 1920 ml of water and boiled down to 240ml. 120 ml of this decoction is mixed with sugar and given twice a day.[8]

### b) *Nasyakarma* (Errhine therapy)

1. Tubers of *Cyperus rotundus* (Family: Cyperaceae; Sinhala name: *Kalanduru*), fresh leaves of *Calotropis gigantea* (Family: Asclepiadaceae; Sinhala name: *Wara*) and *Cleome gynandra* (Family: Cleomaceae; Sinhala name: *Wela*) are ground with water and juice is extracted. *Nasya Karma* is performed by instilling extracted juice into nostrils of the persons with scorpion sting.[7]
2. Fresh leaves of *Calotropis gigantea* (Family: Asclepiadaceae; Sinhala name: *Wara*) and *Cleome gynandra* (Family: Cleomaceae; Sinhala name: *Wela*) are ground with water and juice is extracted. *Nasya Karma* is performed using extracted juice.[9]
3. Seeds of *Butea monosperma* (Family: Fabaceae; Sinhala name: *Kala*) and *Pongamia pinnata* (Family: Fabaceae; Sinhala name: *Magul Karanda*) are rubbed on a stone with water. The resultant is used in *Nasya Karma* in the persons with scorpion sting.[7,9]
4. Roots of *Pongamia pinnata* (Family: Fabaceae; Sinhala name: *Magul Karanda*) are rubbed on a stone with water. The resultant is used in *Nasya Karma* in the persons who are having heaviness in the head and headache due to scorpion sting.[8]
5. Fresh rhizome of *Zingiber officinale* (Family: Zingiberaceae; Sinhala name: *Inguru*) is pounded with water and juice is extracted. This is used in *Nasya Karma* in the persons with scorpion sting.[7]
6. Roots bark of *Vitex negundo* (Family: Verbenaceae; Sinhala name: *Nika*) is grounded and juice is extracted. *Nasya Karma* is performed using this extracted juice in treatment of scorpion sting.[10]
7. Seeds of *Erythrina variegeta* (Family: Fabaceae; Sinhala name: *Erabadu*) and *Pongamia pinnata* (Family: Fabaceae; Sinhala name: *Magul Karanda*) are ground with water, juice is

extracted but squeezing and use in *Nasya Karma* in the persons with scorpion sting.[10]

**c) Local application**

**On the site of scorpion sting**

1. Resin of *Ferula foetida* (Family: Umbelliferae; Sinhala name: *Perunkayam*) is to be dissolved in water and applied on the site of the scorpion sting.[7]
2. Leaves of *Pongamia pinnata* (Family: Fabaceae; Sinhala name: *Magul Karanda*) are crushed and applied on the site of the scorpion sting.[9]
3. Apply *Cassia occidentalis* (Family: Fabaceae; Sinhala name: *Peni Tora*) leaves dipped in salt water to the site of the scorpion sting.[9]
4. Resin of *Ferula foetida* (Family: Umbelliferae; Sinhala name: *Perunkayam*) is ground with juice of betel leaves and applied on the site of the scorpion sting.[11]
5. Leaves of *Acalypha indica* (Family: Euphorbiaceae; Sinhala name: *Kuppameniya*) are ground with lime (Calcium oxide) and applied to site of the scorpion sting.[7,9,12]
6. Entire plant of *Acalypha indica* (Family: Euphorbiaceae; Sinhala name: *Kuppameniya*) are pounded and juice extracted. This juice is mixed with lime(Calcium oxide) and applied to site of the scorpion sting.[11]
7. Juice extracted from fresh leaves of *Datura metel* (Family: Solanaceae; Sinhala name: *Attana*) is applied on the site of the scorpion sting.[7,9,12]
8. Dried resin-like gums of the tree *Shorea oblongifolia* (Family: Dipterocarpaceae; Sinhala name: *Dummala*) is mixed with ghee and applied on the site of scorpion sting.[7]
9. *Calamus thwaitesii* (Family: Arecaceae; Sinhala name: *Ma-wewel*) are ground with coconut vinegar and applied on the site of scorpion sting.[7]
10. Roots of *Achyranthes aspera* (Family: Amaranthaceae; Sinhala name: *Ratkaralheba*) are crushed and applied on the site of the scorpion sting.[13]
11. Seeds of *Achyranthes aspera* (Family: Amaranthaceae; Sinhala name: *Ratkaralheba*) are ground together with water and applied on the site of the scorpion sting.[11]
12. Ash obtained by burning coir is mixed with Margosa oil and applied on the site of the scorpion sting.[13]
13. Ash obtained by burning coir is mixed with coconut oil and applied on the site of the scorpion sting.[11]
14. Apply coconut oil on the site of the scorpion sting.[14]
15. Jute rope is burnt and ash is mixed with coconut oil. This mixture is applied on the site of the scorpion sting.[15]
16. Roots of *Calotropis gigantea* (Family: Asclepiadaceae; Sinhala name: *Wara*) is ground with lime juice and applied on the site of the scorpion sting.[15]
17. Leaves of *Calotropis gigantea* (Family: Asclepiadaceae; Sinhala name: *Wara*) are ground with urine and applied on the site of the scorpion sting.[12, 16]
18. Tender leaves of *Calotropis gigantea* (Family: Asclepiadaceae; Sinhala name: *Wara*), fresh rhizome of *Curcuma longa* (Family: Zingiberaceae; Sinhala name: *Kaha* ) and common salt are ground with lime juice and applied on the site of the scorpion sting.[17]
19. Seeds of *Carum bulbocastanum* (Family: Umbelifereae; Sinhala name: *Kaluduru*) and *Cuminum cyminum* (Family: *Apiaceae*; Sinhala name: *Suduru*) and rock salt are ground together with ghee. This paste is applied on the site of the scorpion sting.[15]
20. Curd is applied on the site of the scorpion sting and made to lick it by a cat.[7,9, 18]
21. Latex of *Calotropis gigantea* (Family: Asclepiadaceae; Sinhala name: *Wara*) is ground with ghee and applied on the site of the scorpion sting.[7]
22. Fresh rhizome of *Curcuma longa* (Family: Zingiberaceae; Sinhala name: *Kaha*) is ground with ghee and applied on the site of the scorpion sting. [7]
23. Pericarp of *Terminalia chebula* (Family: Combretaceae; Sinhala name: *Aralu*), Mace and cane sugar jaggery are ground together and applied on the site of the scorpion sting.[7]
24. Seeds of *Butea monosperma* (Family: Fabaceae; Sinhala name: *Kela*) are ground with latex of *Calotropis gigantea* and applied on the site of the scorpion sting.[7]
25. Droppings of crows, old rat droppings and centipedes are ground together and applied on the site of the scorpion sting.[7]
26. Leaves of *Benincasa hispida* (Family: Cucurbitaceae.; Sinhala name: *Puhul*) are ground and juice is applied to site of the scorpion sting.[19]
27. Leaves of *Cassia tora* (Family: Fabaceae.; Sinhala name: *Pethi Thora*) are pounded with common salt, heated on a pan and applied to site of the scorpion sting. [9,19] Mudannayaka, 1962 mentions that dried rhizome of *Curcuma longa* (Family: Zingiberaceae; Sinhala name: *Kaha*) can be added to above preparation.[12]

28. Leaves of *Emilia sonchifoli* (Family: Celastraceae; Sinhala name: *Kadupahara*) are ground with *Thandulodaka* (water obtained by washing raw rice) and applied to site of the scorpion sting.[11]
29. Tender part of the crown of *Carica papaya* (Family: Caricaceae*;* Sinhala name: *Gaslabu*) is ground with lime (Calcium oxide) and applied to site of the scorpion sting.[20]
30. Stem bark of *Moringa oleifera* (Family: Moringaceae*;* Sinhala name: *Murunga*) is ground with asafoetida and applied to site of the scorpion sting.[20]
31. Stem bark of *Moringa oleifera* (Family: Moringaceae*;* Sinhala name: *Murunga*) is ground and applied to site of the scorpion sting.]12]
32. Fresh leaves of *Cassia tora* (Family*:* Caesalpiniaceae*;* Sinhala name: *Pethi Thora)* are pounded, juice is extracted by squeezing mixed with salt water and boiled. This is applied to site of the scorpion sting especially to reduce swelling.[7]
33. Latex of *Calotropis gigantea* (Family: Asclepiadaceae; Sinhala name: *Wara*), sesame seeds and chimney shoot are ground with salt water and boiled with juice of leaves of *C. tora* and applied on the site of the scorpion sting especially to reduce swelling.[7]
34. *Hiriyal* (Chemical name: *Orpiment/Arsenic Sulphide;* Sinhala name; *Hiriyal*) is grounded with Latex of *Calotropis gigantea* (Family: Asclepiadaceae; Sinhala name: *Wara*) and applied on the site of the scorpion sting especially to reduce swelling.[7]
35. Rhizomes of *Acorus calamus* (Family: Acoraceae; Sinhala name: *Wadakaha*), roots of *Vitex negundo* (Family: Verbenaceae; Sinhala name: *Nika*) and *Ficus religiosa* (Family: Moraceae; Sinhala name: *Bo*), seeds of *Adenanthera pavonina* (Family: Fabaceae.; Sinhala name: *Madatiya*) and *Pushkara* (Chemical name: Borax; Sinhala name: *Pushkara*) are ground with cow's urine or human's urine and applied on the site of the scorpion sting.[10]
36. Rhizomes of *Acorus calamus* (Family: Acoraceae; Sinhala name: *Wadakaha*), roots of *Trianthema portulacastrum* (Family: Nyctaginaceae; Sinhala name: *Sarana*) and chimney soot are ground with bee's honey and applied on the site of the scorpion sting. Equal parts of bee's honey and ghee are taken, mixed together and the patient is made to consume the mixture.[10]
37. Roots bark of *Vitex negundo* (Family: Verbenaceae; Sinhala name: *Nika*) is grounded with rock salt and applied on the site of the scorpion sting.[10]
38. Equal quantities of *Manosila* (Chemical name: Arsenic sulfide; Sinhala name: *Manosila*), Ferula asafetida (Family: Apiaceae; Sinhala name; *Perunkaayam*) and rock salt (Chemical Name: Halite/Sodium Chloride; Sinhala name; *Saindava Lavana*) are taken, ground with cow's urine and applied on the site of the scorpion sting.[9,10]
39. Equal quantities of *Yavakshara* (*Yavakshara* is an alkali preparation of prepared with entire plant of *Hordeum vulgare*) dried rhizome of *Curcuma longa* (Family: Zingiberaceae; Sinhala name: *Kaha*), fruits of *Piper longum* (Family: Piperaceae; Sinhala name: *Thippili*), stem of *Coscinium fenestratum* (Family: Menispermaceae; Sinhala name: *Venivelgata*) and kernel of *Abrus precatorius* (Family: Fabaceae; Sinhala name: *Olinda*) are ground with cow's urine and applied on the site of the scorpion sting.[10]
40. Seeds of *Calotropis gigantea* (Family: Asclepiadaceae; Sinhala name: Wara) and *Piper nigrum* (Family: Piperaceae; Sinhala name: *Gammiris*) are taken in equal weights and powdered together and applied on the site of the scorpion sting.[21]
41. Seeds of *Butea monosperma* (Family: Fabaceae; Sinhala name: *Kala*) and *Calotropis gigantea* (Family: Asclepiadaceae; Sinhala name: *Wara*) are pounded and applied on the site of the scorpion sting.[21]
42. Fresh leaves of *Jasminum officinale* (Family: Oleacae; Sinhala name: *Da Saman*) are ground with lime juice and applied on the scorpion sting.[6]
43. Leaves of *Nymphaea nouchal* (Family: Nymphaeaceae; Sinhala name: *Upul*), roots of *Clitoria ternatea* (Family: Fabaceae; Sinhala name: *Katarodu*), fruits of *Piper retrofractum* (Family: Piperaceae; Sinhala name: *Siviya*) and chimney soot are ground with cow's urine and applied on the scorpion sting.[6]
44. Roots of *Trianthema decandra* (Family: Aizoaceae; Sinhala name: *Sarana*), rhizome of *Acorus calamus* (Family: Acoraceae; Sinhala name: *Wadakaha*), and chimney soot are ground with cow's urine and applied on the scorpion sting.[18]
45. Leaves of *Ocimum sanctum* (Family: Lamiaceae; Sinhala name: *Madurutala*), are ground with juice of *Citrus medica* (Family: *Rutaceae*; Sinhala name: *Lapnaran*) and cow's urine and warm the mixture and applied as a paste on the scorpion sting.[4]
46. Leaves of *Andrographis paniculata* (Family: Acanthaceae; Sinhala name: Heen Binkohomba) applied as a paste on the scorpion sting.[21]

**Other sites of the body**

1. *Thalapa* (a paste-like Sri Lankan preparation) is prepared using stem bark of *Schleichera oleosa* (Family: Sapindaceae; Sinhala name: *Kon Gas*) and applied on the flanks of person bitten by the scorpion.[14]

**d) Blow on to the wound**

1. Roots of *Achyranthes aspera* (Family: Amaranthaceae; Sinhala name: Ratkaralheba) is to be chewed and the breath blown on to the site of the scorpion sting.[9,22]

**e) Blow into the ears**

1. Chew some leaves of *Cajanus cajan* (Family: Fabaceae; Sinhala name: *Rata Thora*) and blow the breath into the ear of person bitten by the scorpion.[7]
2. Roots of *Achyranthes aspera* (Family: Amaranthaceae; Sinhala name: *Ratkaralheba*) or *Gossipium arboreum* (Family: Malvaceae; Sinhala name: *Kapu*) are to be chewed and the breath blown into the ear of person bitten by the scorpion. [7]

**f) Fumigation (*Dum ellema*)**

1. Peacock feather should be dipped in ghee and is set afire. It is then extinguished and the smoke arising is used to fumigate the site of scorpion bite.[7, 9,12,21, 22,]
2. Peacock and rooster feathers are mixed with rock salt and sesame oil, set afire and then snuffed out. The site of scorpion sting is fumigated with the smoke arising from this.[7,9] Further, Sushruta describes to add ghee to above mixture.[4]
3. The casualty is covered with a loose cloth. Then turmeric powder is burnt in embers of coconut shells. The smoke arising is directed under the cloth so that the whole body and the site of the sting gets fumigated.[7]
4. Droppings from peacocks, pigeons, roosters and roots of *Saminea saman* (Family: Fabaceae; Sinhala name: Mara) are powdered together and burnt over embers. The body and the site of the sting is fumigated with the smoke arising.[7]
5. Seeds of *Albizia odoratissima* (Family: Fabaceae; Sinhala name: *Mahari/Huri Mara)*, roots of *Punica granatum* (Family: Lythraceae; Sinhala name: *Delum*), latex of *Calotropis gigantea* (Family: Asclepiadaceae; Sinhala name: *Wara*) and *Gomeda* gem stone (Hessonite) are heated together and the site of the sting is fumigated.[7]
6. Equal quantities of leaves of *Azadirachta indica* (Family: Meliaceae; Sinhala name: *Kohomba*), stem bark of *Cocos nucifera* (Family: Arecaceae; Sinhala name: *Thambili*) and old latex of *Artocarpus heterophylus* (Family: *Moraceae*; Sinhala name: *Kos*) are taken, pounded, mixed with sesame oil and burnt in embers of coconut (Family: Aracaceae; Botanical name; *Cocos nucifera*; Sinhal name; pol) shells. The scorpion sting is fumigated with the smoke arising from this. After that tender leaves of *Pagiantha dichotoma* (Family: Apocynaceae.; Sinhala name: *Divi Kaduru*) are ground with salt water and applied on the site of the sting fumigated.[10]
7. Fruits of *Artocarpus heterophylus* (Family: *Moraceae*; Sinhala name: *Kos*), leaves or stem bark of *Azadirachta indica* (Family: Meliaceae; Sinhala name: *Kohomba*) and *Sesamum indicum* seeds (Family: Pedaliaceae; Sinhala name; *Thala ata*) are wrapped in a cloth and soaked in ghee and burnt. Flames are extinguish and the site of the scorpion sting is fumigated.[22]

**g) Fomentation (*Ushma Sweda / Vedu Paama*)**

1. Entire plants of *Tragia involucrate* (Family: Euphorbiaceae; Sinhala name: *WelKahambiliya*), *Mimosa pudica* (Family: Fabaceae; Sinhala name: *Nidikumba*) and *Pogostemon heyneannus* (Family: Labiatae; Sinhala name: *Kollan Gas*) are boiled in water. The vapour is to be directed to the scorpion sting. Then the boiled residue should be ground and applied to the site of the scorpion bite.[10]
2. Rhizomes of *Acorus calamus* (Family: Acoraceae; Sinhala name: *Wadakaha*), roots of *Vitex negundo* (Family: Verbenaceae; Sinhala name: *Nika*) and *Pongamia pinnata* (Family: Fabaceae; Sinhala name: *Magul Karanda*) are boiled in water. The vapour is to be directed to the scorpion sting. Then the boiled residue should be ground and applied to the site of the scorpion bite.[10]
3. Entire plant of *Achyranthes aspera* (Family: Amaranthaceae; Sinhala name: *Gaskaralheba*) are boiled in cow's urine. The vapour is to be directed to the scorpion sting. Then the boiled residue should be ground and applied to the site of the scorpion bite.[10]
4. Leaves of *Erythrina variegeta* (Family: Fabaceae; Sinhala name: *Erabadu*) are boiled in salt water. The vapour is to be directed to the scorpion sting. Then the boiled residue should be ground and applied to the site of the scorpion bite.[10]
5. Entire plant of *Calotropis gigantea* (Family: Asclepiadaceae; Sinhala name: *Wara*) is boiled in human urine. The vapour is to be directed to the scorpion sting. Then boluses are prepared with warm residue and the site of sting is fomented. After the residue is ground with water and applied to the scorpion bite.[10]
6. Entire plant of *Calotropis gigantea* (Family: Asclepiadaceae; Sinhala name: *Wara*) is boiled in

water. The vapour is to be directed to the scorpion sting.[8]

7. The site of the scorpion bite should be fomented with heated leaves of *Calotropis gigantea* (Family: Asclepiadaceae; Sinhala name: *Wara*).[9,22]
8. Leaves of *Calotropis gigantea* (Family: Asclepiadaceae; Sinhala name: *Wara*) are pounded and boluses are prepared using piece of cloth. These boluses are heated using steamer and the scorpion bite should be fomented with the boluses.[12]
9. Rhizome of *Alpinia galanga* (Family: Zingiberaceae; Sinhala name: *Heen Aratta*) is warmed by keeping under the hot ash in a hearth. The site of the scorpion bite is fomented using heated rhizome of *A. galanga*.[10]

**h) Chanting (*Mantra*)**

1. The site of the scorpion sting is chanted while blowing with stem of *Amorphophallus paeoniifolius* (Family: Araceae; Sinhala name: Kidaran) with the following Chant 'Om Kdham Hum Yam Thram Dham Vam Vam Lam Ksham Pham Phem Om Aum Ham Hah Ha Mam Cham Om' [7]
2. The physician's hand should be chanted with 'Om Namo Jah Jah' Manta. Then the site of the scorpion sting should be wiped downwards with physician's hand to remove the poison. [7]
3. The physician's hand should be chanted with "Namo Nalowa Guruluwa Nugayen Gaseem Daveem Thata Visa Natiya" Mantra. Then wipe the site of the scorpion sting with physician's hand).[17]
4. Gently rub the site of scorpion sting with coconut oil while repeatedly chanting the following Mantra, until the pain stops.

   "Om Theri Theri Yesvah" [12]

**i) Beneficial food**

1. Stem bark of *Schleichera oleosa* (Family: Sapindaceae; Sinhala name: *Kon*) is mixed with water and cooked until it become thick. It is called *Kon Thalapa*. This is given as a food to person bitten by the scorpion.[14]

## DISCUSSION

According to the present study, 56 herbs, three minerals and two ingredients of animal origin are used in treatment of scorpion bites by Ayurveda and traditional physicians in Sri Lanka. Some of the medicines are administered orally and most of the medicines are applied externally on the site of scorpion bite or other places of the body. Some medicines are blown on to the wound or blown into the ears. Further, fomentation (*Ushma Sweda / Vedu Paama*), fumigation (*Dum Ellema*) and *Nasya Karma* (Errhine therapy) are also performed to treat scorpion bites. In addition to these therapies, occult chanting (*Mantras*) are used to remove poison from the body and this is known as Visha Bassima. Various foods beneficial in scorpion bites are also described in texts.

Many plants used in Sri Lanka for treatment of scorpion bites are also used in other countries. *Amaranthus viridis, Achyranthes aspera, Calotropis gigantea*, and *Ferula foetida* are used to treat scorpion bites in Pakistan.[23] *Amaranthus viridis, Carum carvi, Achyranthes aspera*, *Cyperus rotundus*, *Abrus precatorius* and *Ricinus communis* are used to treat scorpion bites in Saudi Arabia.[24]

Entire plant of *Acalypha indica* is used to treat scorpion bites. Analgesic and anti-inflammatory activities.[25] of entire plant, antihistaminic, antipyretic and cardioprotevtive effects of leaves[26-28] antioxidant effect of aerial part[29] and Neuroprotective property of roots[30] of *A. indica* are scientifically proven.

Entire plant, roots and seeds of *Achyranthes aspera* are used to treat scorpion bites. Analgesic and anti-inflammatory activities[31] of roots and leaves, antihistaminic and antispasmodic[32] and cardio protective properties of entire plant[33], antipyretic property of leaves[34] and antioxidant property of entire plant[35] of *A. aspera* are scientifically proven.

Rhizomes of *Acorus calamus* is used in treatment of scorpion bites. Analgesic[36] anti-inflammatory[37] antipyretic[38] antioxidant[39], antispasmodic[40] and properties of rhizome[41], cardioprotective[42] property of entire plant and antihistaminic[43] effect of leaves of *A.calamus* are scientifically proven.

Rhizomes of *Alpinia galanga* is used in treatment of scorpion bites and its analgesic,[44] anti-inflammatory[45] and neuroprotective properties[46] have been scientifically proven.

Entire plant of *Amaranthus viridis* is used to treat scorpion bites. Analgesic, antipyretic[47] and cardioprotevtive[48] effects of entire plant and anti-inflammatory[49] and antioxidant[50] properties of leaves of *A. viridis* are scientifically proven.

Leaves of *Andrographis paniculata* is used to treat scorpion bites. Analgesic, antipyretic and anti-inflammatory effects of Andrographolide derivatives of *Andrographis paniculata*[51], antihistaminic, and cardioprotective effects of leaves[52,53], anti-scorpion activity [54] of aerial part of the plant are scientifically proven.

Fruits and old latex of *Artocarpus heterophylus* are used to treat scorpion bites. Anti-inflammatory effects of phenolic compounds isolated

from the fruits of *A. heterophyllus* is proven scientifically. [55]

Leaves of *Benincasa hispida* are used to treat scorpion bites. Analgesic effect of *B. hispida* is proven scientifically.[56]

Leaves of *Cajanus cajan* are used in treatment of scorpion bites and its property of neuroprotection isprovrn scientifically.[57]

Leaves, roots, seeds, latex and entire plant of *Calotropis gigantea* are used in treatment of scorpion bites. Analgesic effect of flowers and latex [58,59], anti-inflammatory and cardioprotective effects of latex [60,61], antioxidant property of leaves and entire plant [62,63], antipyretic and neuroprotective property of roots[64 65], of *C. gigantean* are proven scientifically.

Leaves of *Carica papaya* are used in treatment of scorpion stinging and their analgesic[66], anti-inflammatory[67], antipyretic[68], and antioxidant[69], properties of leaves are proven scientifically.

Seeds of *Carum bulbocastanum* are used in treatment of scorpion bites and their analgesic effect is scientifically proven.[70]

Leaves of *Cassiatora* are used in treatment of scorpion bites and their anti-inflammatory [71] and neuroprotective[72] properties are scientifically proven.

Fruits of *Citrus medica* are use in treatment of scorpion bites. Analgesic,[73] antioxidant[74] and cardioprotective[75] properties of fruits of *C. medica* are scientifically proven.

Leaves of *Cleome viscose* are used in treatment of scorpion bites and their analgesic[76] and antioxidant[77] properties of leaves are scientifically proven.

Roots of *Clitoria ternatea* are used in treatment of scorpion bites. Analgesic and anti-inflammatory,[78] antihistaminic, antipyretic, antioxidant, respiratory protective and neuroprotective[79] properties of roots are proven scientifically.

Stem of *Coscinium fenestratum* is used in treatment of scorpion bites. Analgesic,[80] anti-inflammatory[81] and antioxidant [82] activities of *C. fenestratum* are proven scientifically.

Rhizome of *Curcuma longa* is used in treatment of scorpion stinging. Analgesic,[83] anti-inflammatory,[84] anti spasmodic [85] antioxidant,[86] cardioprotective[87] and neuroprotective[88] properties of rhizome of *C. longa* have been scientifically proven.

Tubers of *Cyperus rotundus*are used in treatment of scorpion stinging. Antihistaminic and antipyretic,[89] anti spasmodic, [90] cardio protective[91] and neuroprotective[92] properties of tubers of *C. Rotundus* have been scientifically proven.

Leaves of *Emilia sonchifoli* are used in treatment of scorpion bites. Analgesic, anti-inflammatory[93] and antioxidant[94] properties of leaves of *E. sonchifoli* are proven scientifically.

Leaves and seeds of *Erythrina variegeta* are used in treatment of scorpion bites. Analgesic and anti-inflammatory[95] properties of leaves of *E.variegeta* are scientifically proven.

*Latex* (gum oleoresin) of *Ferula foetida* is used to treat scorpion bites. Analgesic and anti-inflammatory,[96] antispasmodic,[97] antioxidant[98] and cardioprotective[99] properties of latex (gum oleoresin) of *F. foetida* are scientifically proven.

Leaves of *Fluggea leucopyrus* are used in treatment of scorpion stinging. Anti-inflammatory and antihistaminic[100] properties of aerial part of *F. leucopyrus* have been scientifically proven.

Leaves and roots of *Gossipium arboreum* (Kapu) are used in treatment of scorpion stingings and anti-inflammatory [101] activity of leaves has been scientifically proven.

Seed oil of *Azadirechta indica* (Kohomba) is used in treatment of scorpion bites. Analgesic [102] and anti-inflammatory[103] properties of seed oil of *A. indica* are scientifically proven.

Entire plant of *Mimosa pudica* is used in treatment of scorpion bites. Analgesic and anti-inflammatory activities of leaves[104] and anti-scorpion-venom [105] are scientifically proven.

Stem bark of *Moringa oleifera* is used in treatment of scorpion bites. Cardioprotective [106] property of stem bark of *M. oleifera* is scientifically proven.

Leaves of *Ocimum sanctum* are used in treatment of scorpion bites. Anti-inflammatory[107] antioxidant[108] cardioprotective[109] properties of leaves of *O.sanctum* are proven scientifically.

Fruits of *Piper longum* are used in treatment of scorpion bites. Anti-inflammatory[110] antioxidant and cardioprotective[111] activities of fruit of *P. longum* have been proven scientifically

Entire plant of *Pogostemon heyneannus* is used in treatment of scorpion bites. Antioxidant [112] property of leaves of *P. heyneannus* has been proven scientifically.

Roots, leaves and seeds of *Pongamia pinnata* are used in treatment of scorpion bites. Analgesic and antipyretic, [113] anti-inflammatory and antihistaminic [114] and antioxidant[115] property of leaves are scientifically proven.

Stem bark of *Schleichera oleosa* is used in treatment of scorpion bites. Analgesic and anti-

inflammatory [116] and antihistaminic [117] properties of stem bark have been scientifically proven.

Pericarp of *Terminalia chebula* is used in treatment of scorpion bites. Analgesic and anti-inflammatory,[118] antioxidant,[119] cardioprotective, [120] and neuroprotective,[121] properties of the pericarp are scientifically proven.

Entire plant of *Tragia involucrate* Linn is used in treatment of scorpion stinging. Anti-inflammatory and analgesic activity of root,[122] antihistaminic and respiratory protective property123] of leaves, Nephroprotective and antioxidant property[124] of aerial part of the plant are scientifically proven.

Rhizomes of *Zingiber officinale* (Inguru) are used in treatment of scorpion bites. Anti-inflammatory and analgesic,[125] antioxidant,[126] cardioprotective[127] properties of rhizome are scientifically proven.

Cow's urine and ghee are used in treatment of scorpion bites. Analgesic and antioxidant properties [128,129] of cow's urine are scientifically proven.

Analgesic, anti-inflammatory and anti-histaminic properties of some of the ingredients used to treat scorpion stings are scientifically proven. Therefore, these ingredients help to reduce pain, redness and odema caused by scorpion bites.

Muscle spasm is one of the effects appearing near the sting site. *Achyranthes aspera*,[32] *Acorus calamus*,[40] *Curcuma longa*,[85] *Cyperus rotundus*, [89] *Ferula foetida*[97] also possess anti-spasmodic effect. External application of these plants may become helpful to overcome muscular spasms occurring at the site of scorpion sting.

Pyrexia may occur in scorpion bites. Antipyretic effects of some ingredients mentioned in this study are proven. Therefore, these medicines may be effective in controlling fever.

A study was carried out to evaluate the anti-scorpion venom (ASV) property of *Andrographis paniculata* (AP) in comparison with anti-red scorpion venom serum and this study was aimed to determine its combined effect with anti-red scorpion venom serum. It is concluded that both anti-scorpion venom (ASV) and ethanolic extract of AP, have scorpion venom neutralization property *in vivo* and *in vitro*, when used individually, but their combination provides maximum benefit in all the aspects of anti-venom property. However, further studies are required for elaboration of potentiating action of plant with ASV in humans. Considering the scorpion sting as acute medical emergency, further studies to prepare injectable form of extract of AP will be helpful. Larger *in vivo* doses may be more beneficial. [54]

*Mesobuthus tamulus* (red scorpion) is common in many parts of India. Acute toxicity of the scorpion venom and its neutralization by the *Mimosa pudica* plant extract in-vivo was done. In the acute toxicity and in-vivo neutralization by plant extract in the dose of 1gm/Kg and 2gm/Kg resulted in the mean survival time of 7 minutes and 9.83 minutes respectively. In combination of prazosin+ plant extract the mean survival time was increased to 20.83 minutes. This protective property of *Mimosa pudica* can be exploited in practice where a significant amount of time is lost while shifting the patient from the Primary Health Care Centre to the Tertiary Health Care Centre.[105]

Antioxidant property of many ingredients is scientifically proven. An antioxidant is a molecule that inhibits the oxidation of other molecules. Oxidation is a chemical reaction that can produce free radicals, leading to chain reactions that may damage cells. Antioxidants help to regenerate damaged cells. Dousset *et al*. (2005) hypothesized that scorpion toxins could induce the generation of high levels of free radicals responsible for membrane damage in organs targeted by venom action. They have shown that scorpion toxins cause considerable lipid peroxidation in most vital organs. They have concluded that free radical generation only plays a minor role in the toxicity of scorpion venom. [130] Even though, antioxidants may play a role in overcoming the toxicity of scorpion venom.

Leaves of *Andrographis paniculata* strongly protect the myocardium against isoproterenol-induced infarction and suggest that the cardioprotective effects could be related to antioxidant activities.[131] Deaths due to scorpion sting occur through cardiac failure. Therefore, *Andrographis paniculata* is beneficial in preventing cardiac failure in scorpion stings.

*Acalypha indica* leaves possess possibly active metabolites that protect the cardiac tissue from cardiovascular diseases.[28] Eliyas (2011) reported that entire plant of *Achyranthes aspera* has significant dose dependent protective effect on heart against isoproterenol induced myocardial infarction probably by improving endogenous antioxidant enzyme activities.[33]

Respiratory failure is another cause of death especially in patients with upper respiratory infections or related problems. *Achyranthes aspera* and *Clitoria ternatea* also possess anti-asthmatic effects.[32,79] *Andrographis paniculata* is effective in treatment of respiratory infections.[132] These herbs will help to prevent respiratory failure in scorpion sting.

Although it is well established that symptomatology, morbidity and death following scorpion envenomation are due to increases in neurotransmitter release secondary to toxins binding to voltage-sensitive sodium channels, the mechanism by which venom action is involved in damaging heart, liver, lungs and kidneys remains unclear[130]. Treatments mentioned in the present study to treat scorpion bites are beneficial because some of the ingredients have the neuroprotective property and act as a brain tonic.

## CONCLUSION

Ayurvedic and Sri Lankan traditional physicians are rich with knowledge on treatment of scorpion bites. They use various methods to administer medicines, internally and externally. The properties which are capable of overcoming effects of scorpion bites in some ingredients used for these treatments are scientifically proven.

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