Efficacy of *Shatavari gopakanyadi* decoction in management of *Polon visha* (Viper envenomation): A conceptual review

Palathiratne S.M.[1]*, Kulatunga W.M.S.S.K.[2] and Jayawardana H.G.G.[3]

Abstract

Polon visha (viper envenomation) is an important area of focus in the traditional *Sarpa visha vedakama* (snake-venom treatment system) of Sri Lankan indigenous medicine. *Polon kulaya* according to Sri Lankan indigenous medicine comprises of many varieties of vipers. *Polon kulaya* of Sri Lankan indigenous medicine can be correlated to *Mandalika* type of snakes mentioned in Ayurveda and also to Viperidae family of snakes of modern science. *Shatavari gopakanyadi* decoction is a unique *Kashaya* drug of Sri Lankan indigenous medicine, primarily indicated in the management of *Raktapitta* and *Raktapradara;* yet to date any published research work about this particular decoction or its utility in treatment of viper envenomation, is unavailable. The objective of this review research was to conceptually validate the efficacy of *Shatavari gopakanyadi kashaya* in the management of *Polon visha* envenomation. For this purpose; principal manuscripts of Sri Lankan indigenous medicine, key compendiums of Ayurveda, relevant textbooks of modern science and published research articles were extensively reviewed and analyzed. The antagonisms of the overall pharmacological actions of *Shatavari gopakanyadi kashaya* against *Dosha dushya tatwa* of *Polon visha* envenomation were highlighted. *Shatavari gopakanyadi kashaya* possess *Pitta shamaka*, *Rakta shamaka*, *Rakta stambhana*, *Vishaghna* and *Vrimhana karma* as primary pharmacological actions; which indeed are directly antagonistic to the pathophysiology and *Dosha dushya tatwa* of *Polon visha* envenomation. The accessory pharmacological actions of *Shatavari gopakanyadi kashaya* are *Daha prashamana*, *Varnya*, *Trishna nigrahana*, *Angamarda prashamana* and *Jwarahara*. These actions are also beneficial in the treatment of *Polon visha* envenomation according to case specific suitability and oppose its clinical features. In a Nutshell, thus the efficacy of *Shatavari gopakanyadi* decoction in management of *Polon visha* (viper envenomation) is conceptually validated conclusively as per fundamentals of Ayurveda and Sri Lankan indigenous medicine.

Keywords: Conceptual review, *Polon visha*, *Shatavari gopakanyadi* decoction, Viper envenomation.

Introduction

Currently viper envenomation has become a leading health issue of significant impact, specially in South Asian countries such as Sri Lanka and India. In particular, viper envenomation is the leading cause of mortality among all snake bites in Sri Lanka, hence it is of great importance. Specially the mortality rates of *Daboia russelii* and *Hypnale* genus envenomation are relatively high, in present day Sri Lanka as well. The global distribution and highly venomous nature of Viperidae family of

[1]*Post Graduate Diploma Scholar, Faculty of Indigenous Medicine, University of Colombo, Rajagiriya, Sri Lanka.*
[2]*Department of Ayurveda Pharmacology, Pharmaceutics and Community Medicine, Faculty of Indigenous Medicine, University of Colombo, Rajagiriya, Sri Lanka.*
[3]*Traditional Physician (Sarpa Visha Vishesha), Registered in Sri Lanka Ayurveda Medical Council, Sri Lanka*

**Correspondence: Palathiratne S.M.., Post Graduate Diploma Scholar, Faculty of Indigenous Medicine, University of Colombo, Rajagiriya, Sri Lanka. Email: sasika7palathiratne@gmail.com*

snakes, adds to the significance of this health issue. The available allopathic treatment of polyvalent anti-venom cannot be generally utilized in bites of *Hypnale* genus and complications have been reported in cases of viper bites. Since, ancient times many accomplished Sri Lankan traditional physicians have successfully managed countless cases of viper bites. Therefore, it is high time to explore on the efficacy, conceptual validity and practical utility of treatments of Sri Lankan indigenous medicine (*Deshiya chikitsa*) against snake bites, especially viper envenomations.

Polon visha (viper envenomation) is an important area of focus in the traditional *Sarpa visha vedakama* (snake-venom treatment system) of Sri Lankan indigenous medicine. *Polon kulaya* according to Sri Lankan indigenous medicine comprises of many varieties of vipers. Out of them *Tith polanga* (*Daboia russelii*) and *Veli polanga* (*Echis carinatus*) are unanimously considered as highly venomous and can cause even mortality to humans. *Polon kulaya* of Sri Lankan indigenous medicine can be correlated to *Mandalika* type of snakes mentioned in Ayurveda and also to Viperidae family of snakes of modern science. The Ayurveda treatises Sushruta Samhita and Charaka Samhita have clearly explained the identifying characters, clinical features, *Dosha dushya tatwa* and treatment of the related *Mandalika varga*. Modern science has also stated corresponding particulars about the related Viperidae family.

Shatavari gopakanyadi decoction is a unique *Kashaya* drug of Sri Lankan indigenous medicine, primarily indicated in the management of *Raktapitta* and *Raktapradara.* But, certain lineages of Sri Lankan snake-venom treatment system, such as the Higgoda Warnakulasuriya Parampara of Alawwa, utilize this decoction to successfully manage viper envenomation as well, among other drugs. The earliest original reference of *Shatavari gopakanyadi* decoction is in the Vaidyaka Sarartha Samgrahaya authored by king Buddhadasa.[1] *Shatavari gopakanyadi* decoction is a famous and effective drug in Sri Lankan indigenous medicine, yet to date any published research work about this particular decoction or its utility in treatment of viper envenomation, is unavailable.

The objective of this research was to conceptually validate the efficacy of *Shatavari gopakanyadi kashaya* in the management of *Polon visha* envenomation. For this purpose, pathophysiology and *Dosha dushya tatwa* of *Polon visha* envenomation, as well as Ayurveda pharmacodynamic (*Rasa*, *Guna*, *Virya*, *Vipaka*, *Prabhava* and *Karma*) properties of *Shatavari gopakanyadi kashaya* was reviewed and critically analyzed. Antagonisms of the overall pharmacological actions of *Shatavari gopakanyadi kashaya* against the pathophysiology of *Polon visha* envenomation were highlighted.

Materials and Methods

For this conceptual review; principal manuscripts of Sri Lankan indigenous medicine, key compendiums of Ayurveda, relevant textbooks of modern science and published research articles were extensively reviewed and analyzed. Ayurveda pharmacodynamic analysis for the formula of *Shatavari gopakanyadi* decoction of Vaidyaka Sarartha Samgrahaya was conducted, with reference to the Ayurveda pharmacopeia of Sri Lanka published by the department of Ayurveda. Antagonisms of the overall pharmacological actions of *Shatavari gopakanyadi* decoction to the pathophysiology of viper envenomation were highlighted, thus establishing the conceptual validity of its efficacy.

Results

Sri Lankan traditional medicine perspective

There are many types of vipers mentioned under the *Polon kulaya* of Sri Lankan indigenous medicine such as; *Tith polanga* (Figure 1), *Veli polanga* (Figure 2), *Le polanga*, *Nidi polanga*, *Va polanga*, *Alu polanga*, *Kunu polanga*, *Polontelissa* (Figure 4) etc. Most of them are highly poisonous except *Pala polanga* (Figure 3).[2] *Gata polanga* is usually coined as a synonym of *Tith polanga*, whilst *Kunu polanga* is considered as a synonym of *Kunakatuwa*. The nomenclature of these vipers of the *Polon kulaya*

slightly differ from each manuscript of Sri Lankan indigenous medicine, but the common characteristic feature in all of them is the presence of circular patches or spots in the body and the absence of the hood. According to Purana Sarpa Visha Chikitsa book of Sri Lankan indigenous medicine there are 16 snakes in *Polon kulaya* and the main vitiated *Dosha* due to their bite is *Pitta*, hence *Sheeta virya aushadha* are generally indicated[3]. Most members of *Polon kulaya* possess a triangular head and relatively short stout body. Furthermore, members of the *Polon kulaya* are generally regarded most aggressive and readily attacking. Many textbooks have mentioned being ovoviviparous as a special feature of this family. The *Hypnale* genus is considered as a member of the Viperidae family according to modern science and several textbooks of Sri Lankan indigenous medicine present a similar opinion by placing some members of the *Hypnale* genus as *Polontelissa* in the *Polon kulaya*.[4] But others consider the *Hypnale* genus separately as well, under the nomenclature of *Kunakatuwa*. *Polontelissa* and *Kunakatuwa* are considered similar in general appearance, but the former is regarded as large and more venomous. The name *Polontelissa* implies the meaning of a viper with oily appearance or the raised hump nose nature, whilst the name *Kunakatuwa* implies the suppuration and gangrene occurring nature of the bite site or the usual habitat of the snake being foul places such as garbage dumps.[5] In conclusion, the snakes named as *Polontelissa*, *Kunakatuwa*, *Le Polanga* and *Alu Polanga* can be mostly correlated to members of the *Hypnale* genus, based on the description of their appearance.

Fig. 1: *Tith polanga* / Russell's viper (*Daboia russelii*)

Fig.2: *Veli polanga* / Saw-scaled viper (*Echis carinatus*)

Fig.3: *Pala polanga* / Green pit viper (*Craspedocephalus trigonocephalus)*

Fig.4: *Polontelissa* / Hump-nosed viper (*Hypnale hypnale*)

Ayurveda perspective

The definition and characteristic features of *Polon kulaya* as per Sri Lankan indigenous medicine is almost same as that of the *Mandalika* type of snakes elaborated in *Agada tantra* (clinical toxicology) of Ayurveda. This also bears testimony to the fact that; the system of Sri Lankan indigenous medicine developed as a separate field, but with clear roots from Ayurveda as the mother science. *Agada tantra*

is one among the eight main branches of Ayurveda and according to *Agada tantra* there are two major categories of snakes as *Divya* (divine) and *Bhauma* (terrestrial). *Divya sarpa* are snakes of divine origin with supernatural properties and the eight *Divya sarpa* are named as *Ananta*, *Takshaka*, *Vaasuki*, *Gulika*, *Karkotaka*, *Shamkhapala*, *Padma* and *Mahapadma*, they exert their venom through their mere sight or exhalation. *Bhauma sarpa* or common terrestrial snakes are subdivided into five classes as; *Darvikara*, *Mandali*, *Rajiman*, *Nirvisha* and *Vyantara*, their *Visha adhishthana* (primary site of venom) is fangs. The characteristic features of these five main genera can be identified as follows; *Darvikara* (with a hood), *Mandalika* (hoodless and decorated with circular patches or rings of varied colors), *Rajiman* (hoodless and striped), *Nirvisha* (non-venomous or slightly venomous) and *Vaikaranja* (hybrid species). There are a total of eighty snakes in these five main classes, out of these there are twenty-six kinds of *Darvikara* snakes, twenty-two of the *Mandalika* species, ten of the *Rajiman* class, twelve of the *Nirvisha* category and three of the *Vaikaranja* species.[6]

As per Sushruta Samhita snakes known as *Adarshamandala*, *Sveta-mandala*, *Rakta-mandala*, *Chitra-mandala*, *Prishata*, *Rodhra-pushpa*, *Milindaka*, *Gonasa*, *Vriddha-gonasa*, *Panasa*, *Maha-panasa*, *Venupatraka*, *Shishuka*, *Madana*, *Palimhira*, *Pingala*, *Tantuka*, *Pushpapandu*, *Shadga*, *Agnika*, *Vabhru*, *Kashaya*, *Kalusha*, *Paravata*, *Hastabharana*, *Chitraka* and *Enipada* belong to the family of *Mandalika* species of snakes. The venom of a *Darvikara* snake vitiates and aggravates the bodily *Vayu*, that of the *Mandalika* aggravates the *Pitta*, while that of the *Rajiman* aggravates the *Kapha*. The venom of the *Vaikaranja* snake aggravates the two particular *Dosha* which its parents would have separately aggravated.[7]

In the first stage of bite by a *Mandalika* snake, the poison affects the *Rakta dhatu* (blood and vascular system) and produces shivering followed by a burning sensation in the body, pallor and yellowish skin. In the second stage the poison affects the *Mamsa dhatu* (muscle tissue) which causes an extreme yellowness of complexion plus a burning sensation in the body as well as yellowness of the bite site. In the third stage, the poison affects the *Medas dhatu* (adipose tissue) producing numbness of the eyes, thirst, slimy exudation from the bite site and perspiration. In the fourth stage, it enters the *Koshtha* and produces fever. In the fifth stage, it produces a burning sensation throughout the whole body. The sixth and the seventh stages are identical as those of the bite of *Darvikara* snake.[8]

In all cases of snake-bites; ligatures of cloth, skin, soft fiber or any other soft article (consecrated with the proper *Mantra*), should first of all be bound four fingers apart above the bite site in the event of its occurrence in the extremities, to arrest the further (upward) spread of the poison in the body. As an alternative, the seat of the bite should be incised, bled and cauterized where such a ligature would be found to be impossible. Incision, cauterization, and sucking (of the poisoned blood from the seat of the bite) should be highly recommended in all cases of snake-bites. The seat of the bite by a *Mandali* snake should not; however, be cauterized due to the dominance of *Pittaja* character of the poison. If cauterized the heat aggravates the venom leading to its speedy expansion in the system.[9]

In the first stage of a case of poisoning by the bite of a *Mandali* snake, the treatment is the same as the corresponding stage of a *Darvikara* bite. In the second stage, an *Agada* compound should be administered with honey and clarified butter and after making the patient vomit, medicated *Yavagu* should be administered to him. In the third stage, after the indication of drastic purgatives and brisk emetics, a proper and suitable medicated gruel should be administered. In the fourth and the fifth stages, the treatment would be the same as the corresponding stages of a *Darvikara* bite. In the sixth stage, the drugs of the *Madhura* (*Kakolyadi*) g*hana* taken with milk should be given. In the seventh stage, anti-venomous *Agada* compound in the mode of *Avapida* (snuff) would neutralize the effects of poison. Thus, there are seven stages (*Visha vega*) in the pathogenesis of snake venom according to Sushruta Samhita, whilst Charaka

Samhita declares eight *Visha vega* and the eighth one is considered as fatal. *Mandalika* snakes are considered active at the first three quarters of night time and their bites are regarded as mostly fatal for the elderly age group.[10]

Modern science perspective

There are 14 families of snakes but among them Colubridae, Elapidae, Hydrophidae, Viperidae, Crotalinae, and Viperinae are considered as the families and subfamilies of venomous snakes. Viperidae are a family of venomous snakes found throughout most parts of the world and they are further classified as subfamilies; Azemiopinae (Fea's vipers), Crotalinae (Pit vipers) and Viperinae (True or pitless vipers). Most vipers have keeled scales, stout build with a short tail, triangular shaped head contradistinguished from neck, vertically elliptical pupils and majority are ovoviviparous as well. Pit vipers have specialized heat sensing pits near their nostrils, which help them to detect warm blooded prey.[11]

All members of the Viperidae family generally possess two relatively long solenoglyphous fangs for the purpose of injecting venom. These fangs are considered as the most advanced type, allowing precise delivery of venom similar to an injection needle. Their maxillary bone can rotate back and forth, so the fangs when not in use are folded back against the roof of the mouth. The global distribution of Viperidae snakes includes America, Africa, Eurasia and South Asia. They are not found in Siberia, Ireland, North of the Arctic Circle in Norway, Sweden and Australia. Adder is the only venomous Viperid found in Great Britain.[12]

Venom of Viperidae family of snakes is primarily vasculotoxic and hemotoxic in nature, additionally they contain proteases and certain neurotoxins as well. The clinical features are pain, local swelling, necrosis, local bleeding, generalized bleeding, coagulopathy and hemodynamic instability. The venom may cause vascular endothelial damage, hemolysis, hemorrhage as well as coagulopathy. Death may usually occur due to profuse internal and external hemorrhage induced circulatory collapse (hypovolemic shock) as well as chronic renal failure. Victim's fate is unpredictable and depends on factors such as species and size of snake, amount of venom injected, condition of the patient and pre-existing morbidities. Even with swift and proper treatment sometimes can result in permanent scars or even limb amputations.[13] Only polyvalent anti-venom is available in Sri Lanka and its efficacy is low against the *Hypnale* genus. Moreover, complications such as anaphylaxis and serum sickness have been reported.

Table 1 shows the comparison of characteristics of *Polon kulaya* (Viperidae family) according to different disciplines

Shatavari gopakanyadi decoction

The earliest original reference of this *Kashaya* (decoction) is found in the Vaidyaka Sarartha Samgrahaya authored by great Sri Lankan king and traditional physician Buddhadasa of Anuradhapura kingdom (341-370 A.D.), this book is undoubtedly accepted as the oldest available complete treatise of Sri Lankan Ayurveda or *Deshiya chikitsa*.[17] This decoction is also mentioned in the Vaidyaka Sarasamkshepaya authored by Rajaguru Shri Chandra (16th Century) with some minor variations of used terminology.[18]

Shatavari gopakanyadi kashaya is also quoted in the books; Kashaya Samgrahaya of Godamune Shri Devamitta thero[19] and Kashaya Sagaraya of Dr. S.S. Kodikara, again with some minor variations of used terminology.[20] This decoction is also authenticated and affirmed with ingredients, indications and *Anupana* in the Sri Lankan Ayurveda Pharmacopeia Volume 1, published by the Department of Ayurveda.[21] *Shatavari gopakanyadi kashaya* is also known as the *Shatavari* 10 *kashaya*, since it contains ten herbal ingredients starting with *Shatavari*. Most importantly *Shatavari gopakanyadi kashaya* is to be regarded as a decoction unique to Sri Lankan Ayurveda or *Deshiya chikitsa* (Sri Lankan indigenous medicine), since there is no mention of it in the textbooks of Indian Ayurveda.

Table 1: Comparison of characteristics of *Polon kulaya* (Viperidae family) according to different disciplines

Characteristic	Sri Lankan Indigenous Medicine[14]	Ayurveda[15]	Modern Science [16]
1. Class	*Polon kulaya*	*Mandali*/*Mandalika varga*	Viperidae Family
2. Identifying Features	Non hooded having circular patches	Large, slow, marked with multicolored ring-like or circular spots on the skin and have the glow of the sun or fire	Long solenoglyphous fangs, keeled scales, stout build with a short tail, triangle shaped head with distinct neck, vertically elliptical pupils and ovoviviparous
3. Number	16 Types	22 Types	200 Species
4. Clinical Features	Yellow or red color bite site, bleeding from all orifices, edema, pain, burning sensation and all features of *Pitta* vitiation	Yellow skin, longing for cold, extreme burning sensation in the body, thirst, delirium, fever, hemorrhage through both the upper and lower channels, swelling, suppuration and rapid aggravation of *Pitta*	Pain, local swelling, necrosis, blood loss and coagulopathy, disruption of the coagulating system, hemolysis, kidney failure and death caused by collapse in blood pressure.
5. Nature of Venom	*Pitta kopakara*	*Ushna*, *Amla*, *Pitta kopakara* and *Rakta dhatu dushyakara*	Viperine venom is mostly vasculotoxic, hemotoxic and proteolytic
6. Treatment	*Sheeta virya aushadha*, *Mantra*, *Kenda*, *Swarasa*, *Kashaya*, *Nasya*, *Anjana*, *Vedu*, *Dhuma*, *Guli*, *Taila*, *Alepa*, *Mallum*, *Vishagala*, *Arishta bandhana*, etc	*Sheeta virya aushadha*, *Agada prayoga*, *Suvisi upakrama*	Anti-venom, hemostatics and symptomatic treatment

***Shatavari gopakanyadi kashaya* (*Shatavari* 10 decoction)**

Vaidyaka Sarartha Samgrahaya, *Raktapitta Adhikara*, *Shloka* 20 [22]

"*Shatavari Gopakanya - Chandanoshira Valakaih*, *Satanduliyaka Draksha - Samangotpalayashtibhih*; *Sadhito Nashayedashu - Niryuhah Sasitamadhuh*, *Urdhawamgatam Raktapitta – Madhogam Chobhyamgatam*; *Tatha Pradaramunmadam – Sadaham Vishamajwaram*."

The decoction prepared of; *Hatawariya* (Figure 5), *Iramusu* (Figure 6), *Suduhadun* (Figure 7), *Savandara* (Figure 8), *Iriweriya* (Figure 9), *Sulukura* (Figure 10), *Muddarapalam* (Figure 11), *Velmadata* (Figure 12), *Nilmanel* (Figure 13) and *Velmi* (Figure 14) with sugar and bee's honey (*Anupana*), quickly destroys; *Urdhawagata raktapitta*, *Adhogata raktapitta*, *Ubhayagata raktapitta*, *Pradara* (*Raktapradara*), *Unmada*, *Daha* and *Vishamajwara*.

The decoction is to be prepared according to the standard *Kashaya paribhasha* of Sri Lankan indigenous medicine. Usual dose is 1/2 *Patha* (120 ml) to be orally administered twice a day, before

meals. The shelf life of a *Kashaya* preparation is usually considered as 24 hours.

Fig.5: *Asparagus racemosus*

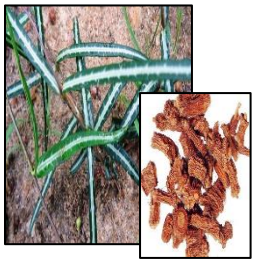

Fig.6: *Hemidesmus indicus*

Fig.7: *Santalum album*

Fig.8: *Vetiveria zizanioides*

Fig.9: *Plectranthus zeylanicus*

Fig.10: *Amaranthus viridis*

Fig.11: *Vitis vinifera*

Fig.12: *Rubia cordifolia*

Fig.13: *Nymphaea nouchali* var. caerulea

Fig.14: *Glycyrrhiza glabra*

Nomenclature and used part of ingredients of *Shatavari gopakanyadi* decoction is mentioned in Table 2.

Ayurveda pharmacodynamic analysis of *Shatavari gopakanyadi* decoction is shows in Table 3.

Table 4 shows the major Ayurveda pharmacological actions of *Shatavari gopakanyadi* decoction.

Table 5 shows the Ayurveda pharmacological actions of *Shatavari gopakanyadi* decoction deduced from the percentage presence of the ingredients in *Dravya ghana.*

Table 6 shows the primary and accessory Ayurveda pharmacological actions of *Shatavari gopakanyadi* decoction useful in the management of *Polon visha* envenomation, with deduced percentages

Discussion

According to Ayurveda normally *Rakta chandana* is indicated as *Chandana* in *Kashaya*, but here in the *Shatavari gopakanyadi kashaya*, Sri Lankan traditional physicians commonly utilize *Shweta chandana* for *Chandana*, particularly due to its higher cooling potency. According to the overall Ayurveda pharmacodynamic properties of *Shatavari gopakanyadi kashaya*; it possesses *Pitta shamaka*, *Rakta shamaka*, *Rakta stambhana*, *Vishaghna* and *Vrimhana karma* as primary pharmacological actions. Accessory pharmacological actions of *Shatavari gopakanyadi kashaya* are *Daha prashamana*, *Varnya*, *Trishna nigrahana*, *Angamarda prashamana* and *Jwarahara*. These primary pharmacological actions are directly antagonistic to the *Dosha dushya tatwa* and pathophysiology of *Polon visha* envenomation and

Table 2: Nomenclature and used part of ingredients of *Shatavari gopakanyadi* decoction

Sanskrit name	Scientific name	Used part	Sinhala name	English name
1. *Shatavari*	*Asparagus racemosus* Willd.	Tubers	*Hatawariya*	Wild asparagus
2. *Gopakanya*	*Hemidesmus indicus* (L.) R.Br.	Roots	*Iramusu*	Indian sarsaparilla
3. *Chandana*	*Santalum album* L.	Heart-wood	*Suduhadun*	Indian sandalwood
4. *Ushira*	*Vetiveria zizanioides* (L.) Nash.	Roots	*Savandara*	Vetiver
5. *Valaka*	*Plectranthus zeylanicus* Benth.	Whole plant	*Iriweriya*	Indian borage
6. *Tanduliyaka*	*Amaranthus viridis* L.	Roots	*Sulukura*	Ox knee
7. *Draksha*	*Vitis vinifera* L.	Fruits	*Muddarapalam*	Dried grapes
8. *Samanga*	*Rubia cordifolia* L.	Stems	*Velmadata*	Indian madder
9. *Utpala*	*Nymphaea nouchali* var. *caerulea* (Savigny) Verdc.	Tubers	*Nilmanel*	Blue water lily
10. *Yashti*	*Glycyrrhiza glabra* L.	Stems	*Velmi*	Liquorice

Table 3: Ayurveda pharmacodynamic analysis of *Shatavari gopakanyadi* decoction

Dravya	***Rasa***	***Guna***	***Virya***	***Vipaka***	***Dosha karma***
1. *Shatavari*	*Madhura, Tikta*	*Guru, Snigdha*	*Sheeta*	*Madhura*	*Vatapitta shamaka*
2. *Gopakanya*	*Madhura, Tikta*	*Guru, Snigdha*	*Sheeta*	*Madhura*	*Tridosha shamaka*
3. *Chandana*	*Tikta, Madhura*	*Laghu, Ruksha*	*Sheeta*	*Katu*	*Kaphapitta shamaka*
4. *Ushira*	*Tikta, Madhura*	*Ruksha, Laghu*	*Sheeta*	*Katu*	*Kaphapitta shamaka*
5. *Valaka*	*Tikta, Kashaya*	*Laghu, Ruksha*	*Sheeta*	*Katu*	*Tridosha shamaka, Kaphapittahara*
6. *Tanduliyaka*	*Madhura*	*Laghu, Ruksha*	*Sheeta*	*Madhura*	*Tridosha shamaka*
7. *Draksha*	*Madhura*	*Snigdha, Guru, Mrudu*	*Sheeta*	*Madhura*	*Vatapitta shamaka*
8. *Samanga*	*Kashaya, Tikta, Madhura*	*Guru, Ruksha*	*Ushna*	*Katu*	*Kaphapitta nashaka*
9. *Utpala*	*Madhura, Kashaya, Tikta*	*Laghu, Snigdha, Pichchila*	*Sheeta*	*Madhura*	*Kaphapitta shamaka*
10. *Yashti*	*Madhura*	*Guru, Snigdha*	*Sheeta*	*Madhura*	*Vatapitta shamaka*
Percentage (%)	*Madhura* =47.37% *Tikta*=36.84% *Kashaya* =15.79%	*Guru* =22.73% *Snigdha* =22.73% *Laghu* =22.73% *Ruksha* =22.73% *Pichchila* =4.55% *Mrudu* =4.55%	*Sheeta* =90% *Ushna* =10%	*Madhura* =60% *Katu* =40%	*Pitta shamaka* =100% *Kapha shamaka* =70% *Vata shamaka* =60%

Table 4: Major Ayurveda pharmacological actions of *Shatavari gopakanyadi* decoction

Karma	***Rasa***	***Guna***	***Virya***	***Vipaka***	***Total average***
Overall percentages of all ten ingredients	*Madhura* = 47.37% *Tikta* = 36.84% *Kashaya* = 15.79%	*Guru* =22.73% *Snigdha* =22.73% *Laghu* =22.73% *Ruksha* =22.73% *Pichchila* =4.55% *Mrudu* =4.55%	*Sheeta* = 90% *Ushna* =10%	*Madhura* = 60% *Katu* = 40%	= 100%
Percentage for *Pitta shamaka*	*Madhura, Tikta, Kashaya*= 100%	*Guru, Ruksha, Mrudu, Pichchila* =54.5%	*Sheeta* =90%	*Madhura*= 60%	= 76.13%
Percentage for *Stambhana* (*Rakta*)	*Kashaya, Tikta, Madhura*= 100%	*Laghu, Ruksha, Mrudu, Pichchila* =54.5%	*Sheeta* = 90%	*Katu*= 40%	= 71.13%
Percentage for *Vishaghna*	*Madhura*= 47.4%	*Guru, Snigdha, Mrudu, Pichchila* =54.5%	*Sheeta* = 90%	*Madhura*= 60%	= 62.98%
Percentage for *Vrimhana*	*Madhura*= 47.4%	*Guru, Snigdha, Mrudu, Pichchila* =54.5%	*Sheeta* = 90%	*Madhura*= 60%	= 62.98%

Table 5: Ayurveda pharmacological actions of *Shatavari gopakanyadi* decoction deduced from the percentage presence of the ingredients in *Dravya ghana*

Karma* / *Ghana	**Percentage presence**
Daha prashamana ghana (Charaka Samhita)[23]	= 60% (6 out of 10)
Jwarahara ghana (Charaka Samhita)	= 30% (3 out of 10)
Varnya ghana (Charaka Samhita)	= 50% (5 out of 10)
Vishaghna ghana (Charaka Samhita)	= 30% (3 out of 10)
Angamarda prashamana ghana (Charaka Samhita)	= 30% (3 out of 10)
Sarivadi ghana (Sushruta Samhita) [24] (*Raktapittahara, Dahanashana, Pittajwaraprashamana, Trishna nigrahana*)	= 50% (4 out of 8)

Table 6: Primary and accessory Ayurveda pharmacological actions of *Shatavari gopakanyadi* decoction useful in the management of *Polon visha* envenomation, with deduced percentages

Primary pharmacological action	**Accessory pharmacological action**
Pitta shamaka (As per *Rasadi pancha padartha* =76.13% As per direct *Dosha karma* =100%)	*Daha prashamana* (= 60%)
Rakta shamaka (Due to similarity in composition and properties with *Pitta dosha*, also as per *Ashrya ashrayi siddhanta* =76.13%)	*Varnya* (= 50%)
Stambhana / *Rakta stambhana* (= 71.13%)	*Trishna nigrahana* (= 50%)
Vishaghna (=62.98%)	*Angamarda prashamana* (= 30%)
Vrimhana / *Tarpana* (=62.98%)	*Jwarahara* (= 30%)

the accessory pharmacological actions oppose its clinical features, thus beneficial in the treatment of *Polon visha* envenomation according to case specific suitability. Furthermore, *Samanga*, *Yashti* and *Draksha* are directly indicated for the treatment of *Mandali sarpa dashtha* according to Charaka Samhita and Sushruta Samhita.[25] Moreover, *Samanga* and *Yashti* are primary ingredients of decoctions directly indicated for viper envenomation according to textbooks of Sri Lankan indigenous medicine.[26]

Modern research has also proved the inhibitory and neutralizing effects of methanolic extracts of *Vitis vinifera* seed as well as methanolic extracts of *Hemidesmus indicus* root against *Daboia russelii* venom. The methanol root extracts of *Hemidesmus indicus* R. Br. and *Pluchea indica* were explored for the first time for neutralization of snake venom (*Vipera russelii*) activity. The *H. indicus* and *P. indica* root extracts significantly neutralized the viper venom-induced lethality and hemorrhagic activity in albino rat and mouse. Venom-induced coagulant and anticoagulant activity was also antagonized by both the extracts. No precipitating bands were observed between the plant extract and polyvalent snake venom antiserum. Maximum neutralization was achieved by *H. indicus* root extract. These observations confirmed that certain Indian medicinal plants possess significant snake venom neutralizing capacity and need further examination for their active constituents.[27] The viper species are known for their violent local effects and such effects have been commonly treated with plant extracts without any scientific validation in rural India. In this investigation, the methanolic extract of grapes (*Vitis vinifera* L.) seed was studied against the Indian *Daboia*/*Vipera russelii* venom-induced local effects. The extract abolished the proteolytic and hyaluronidase activities and also efficiently neutralized the hemorrhage, edema-inducing and myonecrotic properties of the venom. In addition, the extract also inhibited partially the pro-coagulant activity of the venom and abolished the degradation of alpha and beta chains of human fibrinogen. Thus, the extract possesses potent anti-snake venom property, especially against the local effects of viper bites.[28]

Thus, herbal ingredients of *Shatavari gopakanyadi* decoction are to be regarded effective against viper envenomation multifacetedly as per; modern research works, direct indication by authentic Ayurvedic treatises as well as textbooks of Sri Lankan indigenous medicine and most importantly as per fundamental concepts of Ayurveda and Sri Lankan indigenous medicine.

It is notable that the *Gopanganadi kashayam* or decoction mentioned in Sahasrayoga textbook of Kerala Ayurveda *Bhaisajya kalpana* is quite similar in composition and indication to *Shatavari gopakanyadi* decoction.[29] *Gopanganadi kashaya* has ten herbal ingredients and seven of them are same as that of *Shatavari gopakanyadi* decoction. The difference is the inclusion of *Kamala* (*Nelumbo nucifera* Gaertn.), *Vishva* (*Zingiber officinale* Roscoe) and *Madhuuka* (*Madhuca longifolia* (J.Konig) J.F.Macbr.) instead of *Tanduliyaka*, *Draksha* and *Samanga*. Thus, *Shatavari*, *Gopakanya*, *Chandana*, *Ushira*, *Valaka*, *Utpala* and *Yashti* are common ingredients of both decoctions. According to Sahasrayoga textbook, the *Gopanganadi kashaya* is classically indicated in *Pitta jwara*, specially, those associated with *Daha* and *Trishna*, thus this decoction is also known as *Pitta Jwarahara kashaya*. Moreover, this decoction is recommended to be administered when becoming naturally cold after preparation. Interestingly the *Anupana* recommended in both these decoctions are bee's honey and sugar.[30] But the presence of ginger in *Gopanganadi kashaya* would generally deem it contraindicated for use in viper envenomations, owing to the anti-platelet activity of ginger. *Gopanganadi* decoction and *Shatavari gopakanyadi* decoction are another set of examples for the similarity in fundamental concepts and practical application of Sri Lankan indigenous medicine and Indian Ayurveda. Which decoction was first formulated and whether there was any mutual influences, are to be further explored and researched. Table 7 shows the pathophysiological attributes of *Polon visha* envenomation, against the

antagonizing Ayurveda pharmacological actions of *Shatavari gopakanyadi* decoction.

Table 7: Pathophysiological attributes of *Polon visha* envenomation, against the antagonizing Ayurveda pharmacological actions of *Shatavari gopakanyadi* decoction

Pathophysiological attribute	Antagonizing Ayurveda pharmacological action
Pitta kopakara	*Pitta shamaka*
Rakta dhatu dushyakara	*Rakta shamaka*
Atiraktasravakara	*Rakta stambhana*
Laghu, *Ruksha*, *Ushna* and *Amla gunayukta visha*	*Vishaghna* (*Guru*, *Snigdha*, *Sheeta* and *Madhura gunayukta*)
Dhatu dushyakara / *Ojas nashaka*	*Vrimhana* / *Tarpana*
Dahakara	*Daha prashamana*
Peeta and Lohita varnavikritikara	*Varnya*
Trishnakara	*Trishna nigrahana*
Angamardakara	*Angamarda prashamana*
Jwarakara	*Jwarahara*

Conclusion

Shatavari gopakanyadi kashaya possess *Pitta shamaka* (pacifying *Pitta dosha*), *Rakta shamaka* (pacifying *Rakta dhatu*), *Rakta stambhana* (hemostatic), *Vishaghna* (anti-poisonous) and *Vrimhana* (nourishing) *karma* as primary pharmacological actions; which indeed are directly antagonistic to the pathophysiology and *Dosha dushya tatwa* of *Polon visha* envenomation. The accessory pharmacological actions of *Shatavari gopakanyadi kashaya* are *Daha prashamana* (alleviating burning sensation), *Varnya* (complexion promoting), *Trishna nigrahana* (thirst relieving), *Angamarda prashamana* (alleviating body ache) and *Jwarahara* (anti-pyretic). These accessory pharmacological actions are also beneficial in the treatment of *Polon visha* envenomation according to case specific suitability and oppose its clinical features. In a Nutshell, thus the efficacy of *Shatavari gopakanyadi* decoction in management of *Polon visha* envenomation is conceptually validated conclusively as per fundamentals of Ayurveda and Sri Lankan indigenous medicine.

Recommendations

As a result of this research study; the efficacy of *Shatavari gopakanyadi* decoction in management of *Polon visha* envenomation was conceptually validated and established, as per fundamentals of Ayurveda and Sri Lankan indigenous medicine. Thus, it empowers widespread and efficient use of *Shatavari gopakanyadi kashaya* in management of suitable cases of *Polon visha* envenomation, thereby promoting utility of Sri Lankan indigenous medicine in primary health care needs of the Sri Lankan population, by virtue of the safe and efficacious managements thus offered to patients of viper envenomation.

As future related research; organoleptic and physico-chemical analysis of prepared standard sample of *Shatavari gopakanyadi kashaya* can be done with TLC and HPLC assays for identification of active chemical ingredients and pharmacological analysis as per modern science. Future systematic review can be done to summarize the related research findings about all ten herbal ingredients of *Shatavari gopakanyadi kashaya* in order to highlight correlations between Ayurveda pharmacodynamics and modern pharmacological actions. A clinical study can be done by administering *Shatavari gopakanyadi kashaya* to confirmed suitable cases of *Polon visha* envenomation, thereby confirming its efficacy clinically as well. This research bears testimony to the fact that post-Samhita period classical texts of Sri Lankan indigenous medicine are composed of medicinal formulas that, perfectly align with the fundamentals of authentic Indian Ayurveda and future research works of this design are of timely need to validate these significant hypotheses.

References

1. Kumarasinghe A. (1987), Vaidyaka Sarartha Samgrahaya of King Buddhadasa, Department of National Museums, Colombo Sri Lanka, Raktapitta Chikitsa Adhyaya, p565.
2. Liyanarachchi SK., (1956), Sitiyam Sahita Visha Vaidya Chintamani (Volume 1), Saman Printers, Maharagama Sri Lanka, p99.
3. Anonymous (1948), Purana Sarpa Visha Chikitsa, Modern Book Company, First Edition, Nugegoda Sri Lanka, p16.
4. Liyanarachchi S.K., (1956), Sitiyam Sahita Visha Vaidya Chintamani (Volume 1), Saman Printers, Maharagama Sri Lanka, p95.
5. Samarasingha (1952), Sitiyam Sahita Purana Sarpa Vedapota (Volume 2), De Silva AS, Panadura Sri Lanka, p8.
6. Bhishagratna K.L., (1911), An English Translation of the Sushruta Samhita (Volume 2), Bhishagratna K.L., Calcutta India, Chapter 4 Sarpa Dashtha Visha Vignaniya Adhyaya (Kalpasthana), p704.
7. Bhishagratna K.L., (1911), An English Translation of the Sushruta Samhita (Volume 2), Bhishagratna KL, Calcutta India, Chapter 4 Sarpa Dashtha Visha Vignaniya Adhyaya (Kalpasthana), p707.
8. Bhishagratna K.L., (1911), An English Translation of the Sushruta Samhita (Volume 2), Bhishagratna K.L, Calcutta India, Chapter 4 Sarpa Dashtha Visha Vignaniya Adhyaya (Kalpasthana), p713.
9. Bhishagratna K.L., (1911), An English Translation of the Sushruta Samhita (Volume 2), Bhishagratna KL, Calcutta India, Chapter 5 Sarpa Dashtha Kalpa Chikitsita Adhyaya (Kalpasthana), p715.
10. Bhishagratna K.L,. (1911), An English Translation of the Sushruta Samhita (Volume 2), Bhishagratna K.L, Calcutta India, Chapter 5 Sarpa Dashtha Kalpa Chikitsita Adhyaya (Kalpasthana), p718.
11. Wikipedia contributors, (2024, February 27), Viperidae, In Wikipedia, The Free Encyclopedia,https://en.wikipedia.org/w/index.php?title=Viperidae&oldid=1210630845 (Retrieved 10:54, March 28, 2024).
12. Wikipedia contributors, (2024, February 27), Viperidae, In Wikipedia, The Free Encyclopedia, https://en.wikipedia.org/w/index.php?title=Viperidae&oldid=1210630845 (Retrieved 10:54, March 28, 2024).
13. Wikipedia contributors, (2024, February 27), Viperidae, In Wikipedia, The Free Encyclopedia, https://en.wikipedia.org/w/index.php?title=Viperidae&oldid=1210630845 (Retrieved 10:54, March 28, 2024).
14. Wettasinghe Appuhamy D.P., (1961), Sitiyam Sahita Purana Sarpa Vedapota (Volume 1), Karunadhara Printers, Maligakanda Sri Lanka, p15.
15. Tomar S, Jawanjal P., (2019). Comprehensive Account of Sarpavisha with special reference to Brihattrayi. International Journal of Ayurveda and Pharma Research. 7(2): p51-62. https://ijapr.in/index.php/ijapr/article/view/1109.
16. Wikipedia contributors, (2024, February 27), Viperidae, In Wikipedia, The Free Encyclopedia, https://en.wikipedia.org/w/index.php?title=Viperidae&oldid=1210630845 (Retrieved 10:54, March 28, 2024).
17. Kumarasinghe A., (1987), Vaidyaka Sarartha Samgrahaya of King Buddhadasa, Department of National Museums, Colombo Sri Lanka, Raktapitta Chikitsa Adhyaya, p565.
18. Rajaguru S.C., (1984), Vaidyaka Sarasamkshepaya, Department of Ayurveda, First Edition, Nawinna Sri Lanka, Chapter 5 Raktapitta-Murchcha Chikitsa Adhyaya, p144.
19. Godamune Shri Devamitta thero. (1994), Kashaya Samgrahaya, Samayawardhana Publishers, Second Edition, Maradana Sri Lanka, Raktapitta Chikitsa, p131.

20. Kodikara S.S., (1983), Kashaya Sagaraya (Volume 1), Department of Ayurveda, First Edition, Battaramulla Sri Lanka, Raktapitta Roga Kashaya, p206.
21. Department of Ayurveda. (1976), Ayurveda Pharmacopoeia (Volume 1 Part 1), Department of Ayurveda, Nawinna Sri Lanka, p154.
22. Kumarasinghe A., (1987), Vaidyaka Sarartha Samgrahaya of King Buddhadasa, Department of National Museums, Colombo Sri Lanka, Raktapitta Chikitsa Adhyaya, p565.
23. Sharma P.V., (2014), Charaka Samhita - Text with English Translation (Volume 1), Chaukhambha Orientalia, Varanasi India, Chapter 4 Shadvirechanashatashritiya Adhyaya (Sutrasthana), p29.
24. Bhishagratna K.L., (1907), An English Translation of the Sushruta Samhita (Volume 1), Bhishagratna KL, Calcutta India, Chapter 38 Dravya Samgrahaniya Adhyaya (Sutrasthana), p349.
25. Sharma PV. (1998), Charaka Samhita - Text with English Translation (Volume 2), Chaukhambha Orientalia, Fourth Edition, Varanasi India, Chapter 23 Vishachikitsita Adhyaya (Chikitsasthana), p384.
26. Liyanarachchi SK. (1956), Sitiyam Sahita Visha Vaidya Chintamani (Volume 1), Saman Printers, Maharagama Sri Lanka, p103.
27. Alam MI, Auddy B, Gomes A. (1996). Viper venom neutralization by Indian medicinal plant (Hemidesmus indicus and Pluchea indica) root extracts. Phytotherapy Research. 10(1): p58-61. https://doi.org/10.1002/(SICI)1099-1573(199602)10:1<58::AID-PTR775>3.0.CO;2-F.
28. Mahadeswaraswamy YH, Devaraja S, Kumar MS, Goutham YNJ, Kemparaju K. (2009 April). Inhibition of local effects of Indian Daboia/ Vipera russelli venom by the methanolic extract of grape (Vitis vinifera L.) seeds. Indian Journal of Biochemistry and Biophysics. 46(2): p154-160. PMID: 19517992.
29. Nishteswar K and Vidyanath R. (2023), Sahasrayogam- Text with English Translation, Chowkhamba Sanskrit Series Office, Varanasi India, Chapter 1 Kashaya Prakarana, p3.
30. Nishteswar K and Vidyanath R. (2023), Sahasrayogam- Text with English Translation, Chowkhamba Sanskrit Series Office, Varanasi India, Chapter 1 Kashaya Prakarana, p3.