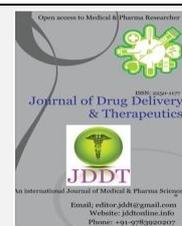


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Review Article

# MEDICINAL PLANTS FOR THE TREATMENT OF SNAKEBITES AMONG THE RURAL POPULATIONS OF INDIAN SUBCONTINENT: AN INDICATION FROM THE TRADITIONAL USE TO PHARMACOLOGICAL CONFIRMATION

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## ABSTRACT

Snakebite is one of the important medical problems that affect the public health due to their high morbimortality. Most of the snake venoms produce intense lethal effects, which could lead to impermanent or permanent disability or in often death to the victims. The accessible specific treatment was using the antivenom serum separated from envenomed animals, whose efficiency is reduced against these lethal actions but it has a serious side effects. In this circumstance, this review aimed to provide an updated overview of herbal plants used popularly as antiophidic agents and discuss the main species with pharmacological studies supporting the uses, with prominence on plants inhibiting the lethal effects of snake envenomation amongst the rural tribal peoples of India. There are several reports of the accepted use of herbal plants against snakebites worldwide. In recent years, many studies have been published to giving pharmacological confirmation of benefits of several vegetal species against local effects induced by a broad range of snake venoms, including inhibitory potential against hyaluronidase, phospholipase, proteolytic, hemorrhagic, myotoxic, and edematogenic activities. In India, a variety of herbal plants are used to cure against the snakebites and other poisonous bites, used either in alone or in combination with other herbal agents. The present study was designed to formulate an attempt to bring together information on medicinal plants that are grown and used for snakebite treatment in India. From a variety of literature sources, data have been compiled with prominence on the plants, family, parts used, etc., depending on the availability of information.

**Key words:** snakebite, India, traditional medicine, medicinal plants, venom, remedy, snakebite treatment.**Article Info:** Received 21 May, 2018; Review Completed 26 July 2018; Accepted 18 Aug 2018; Available online 15 Sep 2018

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## 1. INTRODUCTION

Historically, humans have depended on nature to provide for their fundamental needs, namely food, clothing, medicines, and natural healing remedies. This reliance led the aboriginal people living in synchronization with nature to develop a system of knowledge about plants, which play several important functions in human life (Nasab Khosravi, 2014; Ody, 1993; Rashid *et al.*, 2015). The World Health

Organization estimates that about 80% of the world's population in developing countries depends on plants for the management of a variety of diseases, because of the lack of modern healthcare services (Calixto, 2005; WHO, 2002). Snake envenomations have been a serious yet often overlooked public health threat especially in tropical and subtropical countries, including Southeast Asia (Kasturiratne *et al.*, 2008). The incidence of snakebite is high in India. Apart from mortality, the morbidity is due to various complications.

Approximately 10000 to 50000 snakebite related deaths occur in India each year (McNamee, 2001). In this review was planned to document the medicinal plants used for the treatment of venomous snakebites in throughout the India by rural or tribal peoples.

## 2. OVERVIEW OF AN ETHNOBOTANY

Ethnobotany is the study of how people of a particular culture and region make use of indigenous plants. Since their earliest origins, humans have depended on plants for their primary needs and existence. Plants provide food, medicine, shelter, dyes, fibers, waxes, latex, oils, soaps, resins, gums, tannins, and even contribute a major part to the air we breathe. Examining human life on earth requires understanding the role of plants in historical and current day cultures. (Nasab Khosravi, 2014). Throughout time, countless peoples have tested and recorded the usefulness of plants. Those plants with beneficial uses were kept and utilized. Our cultures evolved by passing from generation to generation ever more sophisticated knowledge of plants and their usefulness. Even today, we depend upon plants and their important medicinal properties for treating the diseases. Hence, documentation of native medicinal knowledge of plant species has contributed to a number of modern drug formulations for primary healthcare (Cox, 2000; Bibi *et al.*, 2014). Medicinal plants are a major source of bioactive compounds that help directly in the handling of ophidian envenomation, or ultimately, as supplements to conservative serum therapy. Thus, plant extracts are an expensive substitute, used either alone or in combination with other agents, when antisera are not available in emergency situations.

Investigation on the conventional use of medicinal plants has achieved significant contemplation within the scientific community in recent years; about 25% of the drugs prescribed worldwide come from plants (Rates, 2001; Jabbar *et al.*, 2007). The conventional system of medicine could not be the entire solution for various human pathological conditions, whereas drug discovery from side to side ethnobotanical study has been found to be one of the most reliable approach and even today this area holds assure for its significant potential (Redizic, 2007; Fabricant and Farnsworth, 2001). Since ancient times, plants have been used for treatment of various diseases. The conventional systems of medicine, together with folklore systems, continue to serve a large portion of inhabitants, particularly in rural and tribal areas despite the advent of modern medicine.

## 3. INDIAN SUBCONTINENT

India is the seventh largest country by the area belonging in South Asia and it has a wide variety of medicinal plants growing under various geographical and ecological conditions. Over 1500 species out of about 15,000 privileged plants species in India have been reported to have medicinal uses (Kosalge & Fursule, 2009). India is composed of 29 states and seven union territories comprising a total area of 3,287,263 km<sup>2</sup>. Indians speak a variety of languages, which include 23 regional languages (Assamese, Bengali, Bodo, Dogri, Gujrathi, Kannada, Kashiri, Kokborok, Konkani,

Maithili, Malayalam, Manipuri, Marathi, Mizo, Nepali, Odia, Punjabi, Sanskrit, Santali, Sindhi, Tamil, Telugu, and Urdu). Moreover, there are many more local or tribal dialects spoken by Indians. India is home to different ethnic groups comprising 5.4 crores of indigenous peoples living in various territories, having diverse cultures, religious rites, and food traditions that separate them from each other. These people also have a healthy awareness of traditional medicine, especially herbal and folk medicine for treatment in snakebites (Harsha *et al.*, 2002; Parinitha *et al.*, 2005). Traditional herbalists function closer to the people, taking improvement of the biodiversity of plant species in such areas to cure various diseases and ailments (Houghton & Osibogun, 1993).

## 4. SNAKES OF INDIA

Snakes have been used to represent war and peace, love and hate, God and devil, as well as life and death; many times they have been used as opposing symbols within the same civilization (Kini and Fox, 2013). Snakebites represent a severe medical, social, and economic challenge in many parts of the world, chiefly in tropical and subtropical nations. Majority of the world's hazardous snakes are found in developing countries, where access to treatment is limited. It is estimated that about 2 million people are bitten annually, resulting in up to 1,25,000 deaths, and 4,00,000 permanent disabilities from severe complications, which may lead to amputation (Jager, 2015). Snake venoms are one of the most intense "mysterious" biological fluids within class Mammalia, having complex medical effects owing to the presence of complex mixtures of proteins and peptides and they contain at least 25 enzymes (Zelanis Tashima, 2015; Russell, 1980; Tu, 1988). There are many potential effects in humans following envenoming by snakes, but just a few extensive categories are of major clinical significance such as systemic myolysis flaccid paralysis, coagulopathy and hemorrhage, cardiotoxicity, renal damage and failure, and local tissue injury at the bite site. Sometimes, it causes secondary effects such as potential morbidity and mortality (White, 2005).

## 5. SNAKEBITES TREATMENT IN INDIA

The treatment of snakebite is as variable as the bite itself. The only available treatment is the usage of antivenom against snakebite. The first antivenom (called an anti-ophidic serum) was developed by Albert Calmette, a French scientist of the Pasteur Institute in 1895, against the Indian cobra (*Naja naja*). Antivenom binds to and neutralizes the venom, stopping further damage, but do not reverses the damage already done. Some individuals may react to the antivenom with immediate hypersensitivity reactions. Other alternative treatment involves the usage of folk and traditional medicines in snake bites. Medicinal herbs are the local heritage in the global importance. Various plants have been used against snake bite, in folk and traditional medicine (Ramaswamy *et al.*, 2018). Currently, a large number of plants and plant materials are being screened for pharmacological activities especially those used in traditional or folk medicine against different diseases.

Over the years, many attempts have been made for the development of snake venom antagonists especially from plant sources in spite of the existence of antiserum. Many Indian medicinal plants or plant materials are recommended for the treatment of snakebite and some are tested, but so far no systematic analysis has been done (Harsha *et al.*, 2002; Parinitha *et al.*, 2005; Samy *et al.*, 2008; Bhandary, 1996).

## 6. PROCEDURE FOR REVIEW OF THIS WORK

In this systematic review, we assemble information on medicinal plants that are grown and utilized in various rural areas of India for treatment of venomous snakebites. As this is a detailed inspection, this work also carried out an appraisal of plants used in treatment of snakebite poisoning throughout the India. This paper helps readers to find out more about these plants. The suitable literature was reviewed such as technical studies published in journals, and reports, and we searched for relevant information through various electronic databases (Science Direct, MEDLINE, Scopus and Google Scholar) using keywords such as “medicinal plants”; “snakebite”; “ethnobotany or ethnopharmacology or indigenous or Indian” and “survey”. It is not possible to incorporate all the information about use of medicinal plants for snakebite treatment, so this work chose to focus on information that is easily accessible to researchers. In the past few decades; different ethnic communities have tried to record traditional and tribal knowledge related to medicinal plants.

However, in most cases this information has yet to be made available to the modern world. A list of medicinal plants was produced, showing biological sources, family, part(s) used, method of preparation, and reference(s). In this review, the precision of botanical identification of plants are obtained from the original sources. While preparing the list of medicinal plants, the following points were considered: biological source(s), family, local name(s) part(s) used, method of preparation, and reference(s). The methodology of preparations depends on the accessibility of plant part(s) and necessity of utilization. Often, the preparation was done by the crushing of plant with the help of stone or a wooden piece, and making juice or paste that will be applied on the affected area; sometimes they are also given orally.

## 7. INDIAN SYSTEM OF MEDICINE

In India, there is a group of people known as “Vaidya” (a doctor of herbs, compounder of medicinal preparations such as Churna, Pills, Syrup, Asava, Arishta, Taila), and elderly persons with folk knowledge about the uses of various house hold spices and herbs. Their native beliefs, skills, and cultural practices concerned with people’s health are useful in curing various diseases. Some elderly women with expertise in delivering babies have proficient knowledge about folk medicines for facing day to day health problems, especially among puberty girls, lactating mothers, and pregnant women. As per Indian beliefs, Mother Nature nurtures us. Hippocrates also stated that “Nature cures, not the physician.” Plants are rich sources of medicinal

compounds by which we can cure a variety of diseases, as well as maintain and improve our health (Naik *et al.*, 2014). Ayurveda states that each and every plant has medicinal use; you just need to find the right person to show that. Owing to the various undesirable effects of some modern day drugs, an increasing number of people from both developed and developing countries have turned to medicinal plants (Patel *et al.*, 2010). There is an extraordinary thinking that understanding knowledge is the key for any revolution. India is a mega diverse nation, home to approximately 10% of the world’s species. For the past several thousands of years, India has nurtured a rich cultural heritage, and large numbers of Indians have used a variety of plants through their rituals and cultural activities. Unfortunately, because of the sudden huge increase in population, negligent behavior toward environmental care guidelines, and global climate change, so many species are now on the verge of vanishing. This has had a strong effect on the food chain, standard of living, and cultural practices, rituals of thousands of Indians. To maintain biodiversity, many conservation organizations in India are working to alleviate this trend.

## 8. FAMILY WISE LIST OF MEDICINAL PLANTS USED FOR TREATMENT OF SNAKEBITE IN INDIA

### Fabaceae

#### *Abrus precatorius* Linn.

The 2–3 g of fresh leaves or roots with seeds are made into paste and consumed along with cold water or cow’s milk. Two times a day for 5–7 days to cure any poisonous bite, as well as root powder applied topically (Vijayagiri & Mamidala, 2012).

#### *Albizia lebbek* Benth.

Paste of bark or leaves or flower or whole plant was used to treat the poisonous bites (Khalkho *et al.*, 2015; Sahu *et al.*, 2014).

#### *Butea monosperma* Taub.

Bark paste applied on swelling. Paste of one seed in 10 mL of lemon juice is given orally to treat (Khan *et al.*, 2014).

#### *Clitoria ternatea* Linn.

The root extract is taken along with the root of *A. indica* and *Rauwolfia serpentina* (Sarkhel, 2014).

#### *Desmodium gangeticum* (Linn.)

Half cup root decoction is taken orally (Mathur and Joshi, 2013).

#### *Mucuna pruriens* (Linn.)

Aqueous extract of root is given orally for twice a day (Kunjam *et al.*, 2013).

#### *Tephrosia purpurea* Pers.

Root decoction along with black pepper is prepared and taken orally for 7 days (Sahu *et al.*, 2014).

#### *Uraria picta* Desv.

Leaf paste or root decoction is given twice daily (Jain and Singh, 2010)

### **Euphorbiaceae**

#### ***Acalypha indica* Linn.**

Leaf paste applied over the bitten part or paste smeared on spot of bite for 3 to 4 days (Lal and Singh, 2012).

#### ***Emblica officinalis* Gaertn.**

Root extract is given orally along with black pepper. Leaf juice as well as stem infusion is given orally (Sarkhel, 2014).

#### ***Euphorbia hirta* Linn.**

Latex or whole plant, decoction given orally (Yabesh *et al.*, 2014).

#### ***Euphorbia neriifolia* Linn.**

Latex is applied locally. Root is used with black pepper (Sarkhel, 2014).

### **Acanthaceae**

#### ***Acanthus ilicifolius* Linn.**

For dressing snakebite crushed fruits are used (Ravindran *et al.*, 2005).

#### ***Andrographis echioides* Nees**

Paste of whole plant is given orally with water. It is also applied externally (Alagesaboopathi, 2013).

#### ***Andrographis lineate***

Paste of leaves is applied externally. About 30 g of whole plant paste is directly administered orally (Alagesaboopathi, 2013).

#### ***Rhinacanthus nasutus* Kurz**

Fresh leaves are taken orally as well as the paste of the leaf is applied externally (Basha, 2012).

### **Amaranthaceae**

#### ***Achyranthes aspera* Linn.**

The whole plant extract or root extract is given orally as well as the paste obtained from the root has been used for 3 weeks (Hiremath and Taranath, 2010).

#### ***Amaranthus viridis* Linn.**

Leaves or stem paste are applied externally (Basha, 2012).

### **Ranunculaceae**

#### ***Aconitum balfourii* Muk.**

Tuber paste used externally and internally (Negi *et al.*, 2010).

### **Araceae**

#### ***Acorus calamus* Linn.**

Rhizomes are crushed to paste and given with warm water as well as applied externally (Samy *et al.*, 2008).

#### ***Arisaema tortuosum* (Wall.) Schott**

Paste of the tuber in applied. Infusion of fresh bulb is taken orally thrice a day (Mathur and Joshi, 2013).

#### ***Sauromatum venosum* (Ait.) Kunth**

The paste of tuber is applied on the affected part (Selvanayagam *et al.*, 1995).

### **Adiantaceae**

#### ***Adiantum lunulatum* Linn.**

Rhizome powder used for snake bite (Padal *et al.*, 2013).

#### ***Adiantum philippense* Linn.**

Powder of rhizome is used (Malviya *et al.*, 2012).

### **Rutaceae**

#### ***Aegle marmelos* (Linn.)**

Decoction or extract for twice a day upto 5 days of the leaves is given orally or root bark extract is administered internally for every 4h up to 3 days (Samy *et al.*, 2008).

#### ***Murraya paniculata* (Linn.) Jack.**

Infusion prepared from shadily dried root or leaf powder and administered orally for every 1h up to 2 days (Alagesaboopathi, 2013).

### **Amaranthaceae**

#### ***Aerva lanata* (L.) Juss**

Juice is prepared and taken orally for 11 days (Selvanayagam *et al.*, 1995).

#### ***Achyranthes aspera* Linn.**

The whole plant extract or root extract is given orally as well as the paste obtained from the root has been used for 3 weeks (Hiremath and Taranath, 2010).

#### ***Alternanthera sessilis* (Linn.)**

External application of stem and leaf paste is used (Selvanayagam *et al.*, 1995).

#### ***Amaranthus spinosus* Linn**

Paste of leaves is applied locally (Selvanayagam *et al.*, 1995).

#### ***Amaranthus viridis* Linn.**

Leaves or stem paste are applied externally (Basha, 2012).

### **Ranunculaceae**

#### ***Aconitum balfourii* (Bruhl) Muk.**

Tuber paste used externally and internally (Negi *et al.*, 2010).

### **Adiantaceae**

#### ***Adiantum philippense* Linn.**

Powder of rhizome is used (Malviya *et al.*, 2012).

#### ***Adiantum lunulatum* Linn.**

Rhizome powder used for snake bite (Padal *et al.*, 2013).

### **Rutaceae**

***Aegle marmelos* Correa**

Decoction or extract for twice a day upto 5 days of the leaves is given orally or root bark extract is administered internally for every 4h up to 3 days (Samy *et al.*, 2008).

***Murraya paniculata* (Linn.) Jack.**

Infusion prepared from shadily dried root or leaf powder and administered orally for every 1h up to 2 days (Alagesaboopathi, 2013).

**Asteraceae*****Ageratum conyzoides* Linn.**

Paste of leaf with rhizome of *Zingiber officinale* is used (Jeetendra and Kumar, 2012).

***Eclipta alba* (Linn.) Hassk.**

Whole plant juice is given orally for 14 days (Alagesaboopathi, 2013).

***Eclipta prostrata* Linn.**

Leaf paste is applied externally (Alagesaboopathi, 2013).

***Tridax procumbens* Linn.**

The leaves are crushed and the juice is dripped on the wound of snakebite. Juice is taken orally after its dilution with some quantity of water (Marandi *et al.*, 2015).

**Alangiaceae*****Alangium salvifolium* (Linn.f) Wang.**

About 15g of bark, ground with 10–12 black peppers and mixed with 60g animal fat, is given every 2h to cure snakebite. Root bark decoction is given internally to treat (Rao and Sunitha, 2011).

**Loganiaceae*****Strychnos nux-vomica* Linn.**

Root bark juice in cow's milk is externally rubbed 3–4 times a day, to treat. The seed powder is also used (Samy *et al.*, 2008).

**Apocynaceae*****Tabernaemontana divaricata* Linn.**

The extract of the seed is given as well as crushed, paste applied on bitten area (Bhat *et al.*, 2012).

***Alstoea scholaris* Linn.**

Bark decoction given orally (Khalkho *et al.*, 2015).

***Alstonia venenata* R.Br.**

Tablets made from paste of stem bark are taken with cow's urine. Decoction also taken orally (Thirumalai *et al.*, 2010).

***Holarrhena antidysenterica* Wall**

The root is crushed and applied as well as paste is taken orally with water (Jeetendra and Kumar, 2012).

***Nerium indicum* Mill.**

The root is crushed with roots of *Capparis sepiaria* and *Datura innoxia*, and paste applied externally thrice for 5 days (Khan *et al.*, 2014).

**Caesalpiniaceae*****Caesalpinia bonduc* Linn.**

Seeds paste applied externally for 2 weeks (Samy *et al.*, 2008).

***Cassia alata* Linn.**

Paste of leaves is applied externally as well as given orally (Samy *et al.*, 2008).

***Cassia fistula* Linn.**

The paste and decoction of root bark with black pepper is given orally. Paste of stem bark applied on bitten place (Bhat *et al.*, 2012).

***Cassia tora* Linn**

Root paste and leaf decoction is applied externally for 14 days (Alagesaboopathi, 2013).

**Menispermaceae*****Tinospora cordifolia***

Stem juice or leaf juice along with garlic paste is applied on the spot and also taken orally for 3 to 4 days (Sarkhel, 2014).

***Cissampelos pareira* Linn**

Root paste with long pepper is prescribed once daily for 5 days (Kumar and Choyal, 2012).

***Cocculus villosus* DC.**

The root bark extract is given internally and applied (Jeetendra and Kumar, 2012).

**Asclepiadaceae*****Tylophora indica* (Burm. f.) Merr.**

Paste of leaf and root is mixed with equal amount of root paste of *Rauwolfia serpentina* and applied externally on the spot as well as leaf juice alone is also taken internally (Alagesaboopathi, 2013).

***Calotropis gigantea***

Root bark is ground into paste and made into pills n given orally (Rao and Sunitha, 2011).

***Gymnema sylvestre* Retz.**

Root Tincture or leaf powder taken orally for 4 days (Nagaraju and Rao, 1990).

***Hemidesmus indicus* Linn.**

Aqueous extract of root is prepared in water and given orally, and root paste is applied two or three times a day (San *et al.*, 2011).

**Liliaceae*****Allium cepa* Linn.**

Paste taken from fresh skin bulb for external application for 5 days (Samy *et al.*, 2008).

***Allium sativum* Linn.**

Bulb is made into paste and given orally (San *et al.*, 2011).

***Gloriosa superba* Linn.**

Root paste or tuber paste is applied externally for 2 to 5 days (Samy *et al.*, 2008).

**Meliaceae*****Azadirachta indica***

Decoction or paste is prepared and given orally for 7 days (Sarkhel, 2014).

***Soyimida febrifuga* Juss.**

Fresh bark of this plant together with root of *H. pubescens* are made into paste, and mixed with drinking water, given orally three times a day for 3 days (Kunjam *et al.*, 2013).

**Scrophulariaceae*****Bacopa monnieri***

Juice mixed with castor oil is applied externally to treat. Leaf powder decoction mixed with hot cow's milk taken orally (Sarkhel, 2014).

***Verbascum Thapsus* Linn.**

The infusion of whole plant is given (Kumar and Choyal, 2012).

**Caricaceae*****Carica papaya* Linn.**

Unripped fruit of *Carica papaya* is taken and the skin is removed by slicing. Salt is then rubbed over it. The fruit

is then placed over the bite with sliced portions in contact with the bite and bandaged. Few drops of latex are applied to wound due to snakebite for quick healing (Khan *et al.*, 2014).

**Costaceae*****Costus speciosus* Koen**

Rhizome and root paste is used internally and externally (Kumar and Choyal, 2012).

**9. CONCLUSION**

One valuable gift to human health is provided by nature in the form of medicinal plants in the locality and one of the significant ways in which humans directly reap the benefits provided by biodiversity. India has long history of medicinal plant utilization in traditional and tribal culture. From the present review, a total of 67 species from 24 plant families have been used against snakebites, as reported by different ethnobotanical investigations mostly carried out during the past few years in India. In this review, we focused on the collection of data for the most frequently used plants in snakebite treatment. This work tried to be the most comprehensive review to date, and it shows striking similarities between medicinal plant uses in different nations. Thus, by triangulation, it is probably still possible to document most of the knowledge, but further research should continue, especially in areas within nations that have received less attention. Ethnobotanical investigation of drug discovery has been found to be one of the most reliable approaches toward use of medicinal plants for treatment of various conditions, and even now, there are still many more things for us to discover.

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