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ANTIVENOM HERBAL FORMULATIONS USED AGAINST SNAKEBITES BY THE OROAN TRIBALS OF LATEHAR, JHARKHAND

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ABSTRACT

Snake bite is one of the major health hazards in Latehar District of Jharkhand. An Ethnomedicinal survey was undertaken in the district to document the traditional remedies for snakebites practiced by the Oraon tribals. The mode of data collection was done through questionnaire and personal interviews with the reputed tribal healers during the field visits. The investigation reveals that most of the Oraon tribals of the district still rely on traditional medicine for their primary health care. The herbal formulations are of great interest and may have effective anti-venom activities leading to the detoxification of the victim. The present study was aimed at documentation of antivenom herbal formulations used against snakebites and availing them to the scientific world and the society.

KEYWORDS: Snakebites, Snake venom, Antivenom, Herbal formulations, Latehar, Oraon tribals.

INTRODUCTION

The snakebite is one of major health hazards in rural India leading to high mortality rate especially in Jharkhand. According to the latest reports available, over an average of 2,00,000 cases of snakebites are recorded in India every year and about 11,000 - 55,000 die due to snake envenomation.[1][2][3] The hospital records of Jharkhand are few owing to the victims' dependency on traditional healers and practitioners. There are about 240 species of snakes in India of which only 52 species are venomous. The majority of the bites and mortality are attributed only to five species[4][5] which are commonly encountered in Jharkhand. The

Chotanagpur plateau of Jharkhand consists of about 19 species of snakes belonging to 5 families.[6] In the district of Latehar, high mortality rate is due to snake envenomation of the following species - Spectacled cobra *(Naja naja)*, Monocled cobra *(Naja kaouthia)*, Banded krait *(Bangarus fasciatus)*, Common krait *(Bangarus caeruleus)* and four species of vipers, namely Russell's viper *(Daboia russelii)*, Saw scaled viper *(Echis carinatus)*, Green bamboo pit viper *(Cryptelytrops albolabris*, Green vine viper *(Ahaetulla nasuta)*[7] shown in Fig. 2. Nature Conservation Society, Daltonganj has reported the presence of King cobra *(Ophiophagus hannah)* in the Palamau Tiger Reserve but it has not been sighted by the forest dwellers in recent years.

The rich forest flora and vast tribal population in Latehar district have attracted a number of workers for ethnobotanical studies in the past. But no works have been reported exclusively on Oraon tribals and the snakebites. The present study gives the first hand information and attempts to record ethnomedicinal formulations used against the snakebites by the Oraon tribals.

Venom is highly modified saliva containing a mixture of proteins and polypeptides zootoxins used by snakes for defence or to immobilize its prey.[8] Snake venoms are divided into four types based on their mode of action in the human body. They are neurotoxins, cytotoxins, cardiotoxins, and hemotoxins.[9] The neurotoxins (Fasciculins, Dendrotoxins & α-Neurotoxin) are mostly found in the elapids such as cobras, kraits and mambas, whereas viperids such as most vipers contain cytotoxins (Phospholipases). The king cobra contains cardiotoxin venom whereas rattle snakes and some vipers have hemotoxic venoms.[10] Some snakes contain a mixture of both neurotoxins and hemotoxins. Some elapids and viperids carry numerous other types of toxins too.

MATERIALS AND METHODS

Study Area

The district of Latehar, carved out of Palamau district in 2001, lies in North-western part of the state of Jharkhand between 23°75' North latitude to 84°50' East latitude. It has an area of 3671 sqkm and the population is 725,673 according to census 2011. Latehar is a highly hilly and forested district. The average elevation of the district is 400 meters. The climate is moderate with temperature records of 12° to 15°C in the winter and 38° to 40°C in the summer. The annual rainfall ranges from 1200mm to 2000mm at different places. Latehar is predominantly a tribal district with almost 40% of the population belonging to the Scheduled

tribes.[11] The district has nine development blocks (Fig. 1). The tribals chosen for ethnobotanical study are the Oraons who are one of major groups in Latehar district. They are mainly agricultural labourers and also depend on the forest products for their living, which is why the incidents of snakebites are frequent among them. Their dependency on the forests

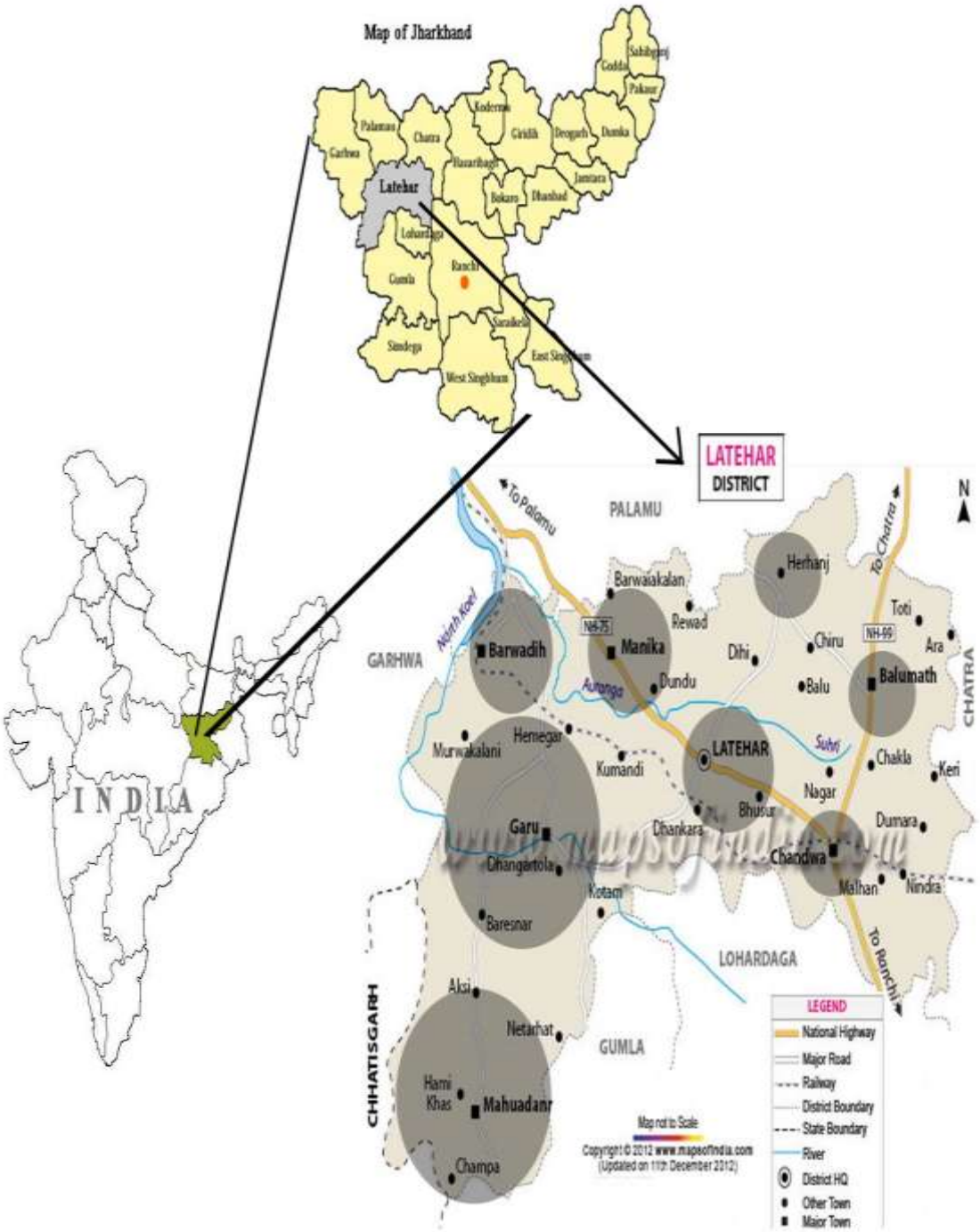

Fig. 1. Map of Latehar District showing Areas of Field Study
(Courtesy: www.mapsofindia.com)

have enriched them with a good heritage on traditional knowledge on health practices.

Fig. 2. Venomous Snakes of Latehar Forests

(Photo courtesy: Mobarak Ansari & Satya Prakash, Jharkhand)

Methodology

An extensive survey was undertaken during the year 2014 in the nine development blocks of Latehar district, namely Mahuadanr, Garu, Barwadih, Latehar, Chandwa, Balumath, Herhanj, Manika and Bariatu (**Fig. 1**). The reputed tribal healers specialized in venom detoxification were identified from each development block with the help of tribal leaders. The ethnobotanical data were collected by personal interviews which were recorded with an MP3 recorder system. The semi-structured questionnaires were prepared to record the local names of the medicinal plants, parts used, methods of preparation, dose and the mode of administration. The medicinal plants were photographed using a digital camera (Canon EOS 1200D) and the voucher specimens were collected with the help of the tribal healers. The specimens were identified with their botanical names and deposited in the Rapinat Herbarium, Tiruchirappalli, India.

RESULTS AND DISCUSSION

The ethnobotanical formulations used against specific type of venomous snake are given in **Table 1** and they are arranged according to the type of snakebites. For every formulation, the botanical names of the antivenom plants are given followed by local names in parenthesis. The method of preparation and the mode of administration are given under antivenom

formulations using the local names and the amount required. The 'unknown snakes' refers to victim's inability to recognize the venomous snake. It also means that the victim could not see the snake due to darkness or thick bushes in the forest.

Table 1: Ethnomedicinal Formulations used against snakebites in Latehar District

Type of Snakebites	Botanical Name/(Local Name)	Antivenom Formulations
Cobras *(Naja naja & Naja kaouthia)*	*Andrographis echioides* Nees / (Gusum puru) *Aristolochia indica* L. / (Ishwarmool) *Rauvolfia serpentina* L. / (Nagbael, Sarpagandha)	*Gusum puru* whole plant 6g, *Ishwarmool* roots 5g and *Sarpagandha* roots 5g are ground well and dissolved in a cup of water. One spoonful of the solution is administered orally at every 30 minutes. The solution is also applied on entire part of the body where the snake has bitten.
	Vitex penduncularis Wall / (Charaigorh) *Tridax procumbens* L. / (Kharha ghans)	*Charaigorh* bark 5g is ground into a paste. It is dissolved in a cup of water and administered orally. The dosage is repeated for three times within an hour. At the same time, the fresh leaves of *Kharha ghans* are crushed in the hands and the juice is dropped on the wound. The leaf paste is applied on the wound.
	Cassia fistula L. / (Sonarki, Bandarlauri) *Piper nigrum* L. / (Golgi)	5g root bark of *Cassia fistula* and 7 pieces of *black pepper* are ground into a paste. The paste is dissolved in a glass of water. A spoonful of the solution is administered orally every 30 minutes. The paste is also applied in the body part of snake bite and gently massaged downward.
Kraits *(Bangarus fasciatus & Bangarus caeruleus)*	*Cassia fistula* L. / (Sonarki, Bandarlauri) *Hemidesmus indicus* (L.)R.Br. / (Choti dudhia) *Piper nigrum* L. / (Golgi)	*Bandarlauri* root bark (5g), *Choti dudhia* root 5g and 7 pieces of *black pepper* are ground into a paste. The paste is dissolved in a glass of water. A spoonful of the solution is administered orally at every 30 minutes. The paste is also applied in the body part of snake bite and gently massaged downward.
	Aristolochia indica L. / (Ishawarmool) *Rauvolfia serpentina* L. / (Nagbael, Sarpagandha) *Hemidesmus indicus* (L.)R.Br. / (Choti dudhia) *Cyperus rotundus L.* / (Nagar Motha) *Andrographis echioides* Nees	*Ishawarmool* roots 2g, *Sarpagandha* roots 5g, *Choti dudhia* roots 8g, *Nagar motha* rhizome 8g and *Gusum puru* whole plant 6g are ground into a paste and dissolved in a glass of water. One half of the solution is administered orally and the other half is applied in entire body. The treatment is repeated at the interval of 2 hours. For the second and the third day, only two doses are given.

	/ (Gusum puru)	
Vipers *(Daboia russelii, Echis carinatus & Ahaetulla nasuta)*	*Calotropis gigantea* L. / (Gadsa, Akwan) *Vitex penduncularis* Wall / (Charaigorh) *Elaeodendron glaucum* Pers. / (Bhairao, Niuri)	The paste of *Akwan* root bark (5g) is applied in the wound immediately to reduce the pain. The paste of *Charaigorh* bark (5g) is dissolved in a cup of water and administered orally. The dosage is repeated for four times with a time interval of 30 minutes. The paste of *Bhairao* bark is applied on the inflammation. In case of gangrene, the paste is applied much thicker.
	Aristolochia indica L. / (Ishawarmool) *Rauvolfia serpentina* L. / (Nagbael, Sarpagandha) *Hemidesmus indicus* (L.)R.Br. / (Choti dudhia) *Cyperus rotundus L.* / (Nagar Motha)	*Ishawarmool* roots 2g, *Sarpagandha* roots 5g, *Choti dudhia* roots 8g and *Nagar motha* rhizome 8g are ground into a paste and dissolved in a glass of water. One half of the solution is administered orally and the other half is applied in entire body. The treatment is repeated for four times at the interval of 30 minutes. On days 2-5, only two dosages are given.
	Elaeodendron glaucum Pers. / (Bhairao, Niuri) *Madhuca indica* Gmel / (Madgi, Mahua, Dori) *Cassia fistula* L. / (Sonarki, Bandarlauri)	5g each of *Bhairao* bark, *Dori* cake and *Bandarlauri* root bark are ground into a paste. Then 2ml of *Kerosene* and 2mg are *Chuna* are added and mixed well. The paste is applied on the inflammation to stop swelling. *(Dori cake – cakes obtained after extraction of oil from the seeds; Chuna – Slaked lime)*
Unknown Snakes	*Aristolochia indica* L. / (Ishawarmool) *Rauvolfia serpentina* L. / (Nagbael, Sarpagandha)	2g root of *Ishawarmool* and 2g root of *Sarpagandha* are ground together into a paste. Half teaspoon of the paste is administered orally at every 15 minutes. The paste is also applied in the body part of snake bite.
For all Venomous Snakes	*Aristolochia indica* L. / (Ishawarmool) *Rauvolfia serpentina* L. / (Nagbael, Sarpagandha) *Withania somnifera* L. / (Ashwagandha) *Acorus calamus* L. / (Ghorbach) *Stephania hernandifolia* L. / (Parhilata) *Cassia fistula* L. (Sonarkhi, Bandarlauri) *Elaeodendron glaucum* Pers. /	*Ishawarmool* roots 50g, *Sarpagandha* roots 50g, *Ashwagandha* roots 50g, *Ghorbach* rhizome 50g, *Parhilata* tubers 25g, *Bandarlauri* bark 100g, *Bhairao* bark 100g, *Peepli* fruits 25g, *Sonth* 50g *Golki* 25g, *Nagar Motha* rizhome 50g. *(Sonth – dried rhizomes of zinger)* The dried plants parts for the above ingredients are powdered separately. The powders are mixed well as per the measurement and stored in an air tight glass container. 1mg of the powder is given to the victim for 7 times at 3 minutes gap after each dosage.

	(Bhairao, Niuri) *Piper longum* L. / (Pippali) *Zingiber officinale* R. / (Sonth) *Piper nigrum* L. / (Golki) *Cyperus rotundus* L. / (Nagar Motha)	At the same time, locally made snake stone is placed on the wound after bruising it.
Venom Sucking Plants	*Canavalia virosa* L. / (Bischusi)	The wound is bruised and the seed is applied on the wound after removing the seed coat. It sticks to the skin till the poison is completely removed and falls off. *Done along with above formulations.*
	Typhonium trilobatum Schott. / (Nirbis)	The paste of the corm is applied on the wound. *Done along with above formulations.*

DISCUSSION

The folk remedies of snakebites consisting of simple methods of treatment was developed by trial and error method over a long period. They still hold an important place in several tribal societies[12], especially for the first aid. The traditional healers of the Oraon tribals have developed unique formulations for specific snakes. It is not a single plant used in detoxification of the victim but a combination of several antivenom plants. The survey revealed that several cases of snakebites have been successfully treated by the given formulations. Some of the reputed tribal healers have treated snake envenomation cases as follows - Praful Xalxo (700), Theodor Panna (200), Khushdil Tirkey (60), Pauru Nagesia (40).

The tabulated data reveal that the roots of *Aristolochia indica, Rauvolfia serpentina, Hemidesmus indicus, Acorus calamus* and *Cassia fistula* are common ingredients in several formulations. Two species, namely *Andrographis echioides* and *Vitex penduncularis* are being reported for the first time to be used as antivenom. The former is added in two formulations for neutralizing cobra and krait venom while the latter is used only against viper venom. *Elaeodendron glaucum* also surfacing for the first time, is used only against inflammation induced by vipers.

Research Evidences of Antivenom Activities of Plants

Several researchers have evidenced the neutralizing capacity of the snake envenomation with methanolic or ethanolic extracts of *A. indica, R. serpentina, H. indicus, A. calamus, Withania somnifera, Cassia fistula* and *Calotropis gigantea.* Aristolochic acid found in *Aristolochia*

indica produces increase in immune response and it also inhibits the lytic activity and the edematose properties of some phospholipases of snake venoms.[13] Methanolic extract of *A. indica* roots effectively neutralizes the *Daboia russelii* venom induced lethal activity. Various pharmacological activities including oedema, haemorrhagic, coagulant, fibrinolytic and phospholipase activities were significantly neutralized by the plant extract.[14]

The roots of *Hemidesmus indicus* contain Hexatriacontane, Lupeol octacosanoate, Hemidesminine, Hemidesmin-I and Hemidesmin-II as the major constituents.[15] The compound, 2-OH-4-Methoxy Benzoic acid was isolated and purified from the roots of *Hemidesmus indicus* and was found to contain anti-inflammatory, antipyretic and antioxidant properties. The compound effectively neutralizes inflammation induced by *Vipera russelii* venom.[16] Lupeol acetate isolated and purified from the methanolic root extract of *H. indicus* significantly neutralizes lethality, haemorrhage, defibrinogenation, oedema, PLA2 activity induced by *Daboia russelii* venom. The compound also neutralizes *Naja kaouthia* venom induced lethality, cardiotoxicity and neurotoxicity.[17] Maximum neutralization of *Vipera russelii* venom was achieved by methanolic extracts of *H. indicus* roots.[18]

The various alkaloids identified in *Rauvolfia serpentina* include reserpine, reserpiline, serpentine, serpentinine, yohimbine, ajmaline, deserpidine, rescinnamine, etc.[19] The root extract of *R. serpentina* effectively neutralizes the lethality and haemolytic activities of *D. russelii* venom and also all the toxic effects induced by the it.[20] Ethanolic extracts of *R. serpentina* effectively neutralized also *Naja naja* venom induced lethal activity. The alkaloid reserpine exerts the inhibitory action against the venom of cobra. *R. serpentina* PLA2 inhibitors were purified from the ethanolic extracts of the plant.[21]

Neutralization effects of *Acorus calamus* and *Withania somnifera* root extracts have been tested against *Echis carinatus* venom. Both the plant extracts effectively neutralized the various pharmacological activities like haemorrhagic, coagulant, oedema and phospholipase activities induced by *E. carinatus* venom.[22]

Traditionally, the Oraon tribals have been using *Cassia fistula* and *Calotropis gigantea* with black pepper to neutralize cobra and viper venom respectively. The hydroalcoholic extracts of *C. fistula* and *C. gigantea* have a significant inhibitory effect on haemolysis, procoagulant and oedema-forming activity. *C gigantea* extract has more neutralizing capacity on *Naja naja* venom as compared to *C. fistula*.[23]

Types of Commercial Antivenoms Used

The types of antivenoms used for the treatment of snake envenomation are classified into monovalent (effective against a given species' venom) and polyvalent (effective against several different species). The Generic names of the antivenom are Equine and Ovine Immunoglobulins, which are horse derived and sheep derived respectively.[24]

Side Effects of Antivenom Therapy

The side effects of antivenom therapy are anaphylactic reactions (difficulty in breathing, swallowing, unusual weakness, redness of skin, itching, swelling of eyes, etc), serum sickness (enlargement of lymph glands, fever, rash, inflammation of joints), pyrogen reactions and renal failure.[25] In this regard, the herbal remedies are the better alternatives.

Future Scope

Most of the medicinal plants listed above, have been screened individually for their antimicrobial, pharmacological and antivenom properties. The survey reveals that the efficacy of medicinal plants is based on using them in right combination and appropriate amount of several plants. The underlying principle of efficacy of the herbal formulations may lie in the synergistic activity of diverse compounds from diverse medicinal plants, rather than a single compound from a single plant.[26] To validate the claimed antivenom properties of these formulations, pharmacological screening of the extracts is essential both *in vitro* and in *in vivo* conditions. This will lead to the isolation and characterization of bioactive chemicals produced in the reaction mixture which may further lead to the formulation antidotes with no side effects.[27]

Moreover, snake venom is a cocktail of various proteins and polypeptides which act in combination to induce various pharmacological effects on victims. Hence, a single active compound from the medicinal plant may not be effective in neutralizing the toxic effect of venom components. Therefore, the alternative approach is to isolate the active compounds, then prepare a mixture of these active components in a predetermined ratio to use as effective antidote against snakebite.[28] That is to say – a cocktail of antivenom to neutralize the cocktail of snake venom. Such an antivenom would be advantageous over commercial antivenom in the following ways – minimal or no side effects, stable at room temperature. Moreover, the use of plant antivenoms will reduce the use of horses and sheep for antivenom production.

CONCLUSION

The herbal formulations have antivenom activity which have no side effects unlike the commercial antivenom therapy. The first aid with these formulations reduces the mortality rate against snakebites. If these herbal formulations are scientifically evaluated and disseminated among the rural folks, many lives can be saved every year. The survey of literature reveals that the combined applications of plants extracts exhibit more physiological effect than the sole extracts for the remedy of snakebites.

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