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Zoo Therapeutic uses of Snake Body Parts in Folk & Traditional Medicine

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ABSTRACT

Search for bioactive molecules from natural products emerged as new arena of research from the onset of 19th century. Some of the molecules proved effective in the field of biomedical application, especially in alleviating human pain and suffering. Natural products despite being an alternative source of drug discovery there is shortage of lead compounds from it getting into pharmaceutical research probably because of lack of compatibility between the source and high-throughput screening.

Natural products are classified into two major classes depending upon its source of origin: plant and animal based natural product. Snakes and its body parts (blood, meat, fat, bile, venom, shed skin) have been used in folk and ethno medicine of various cultures since ancient time for zoo therapeutic purposes. This present review aims to report the folk and traditional medicinal uses of snake and its body part.

Keywords: *Snake meat, Snake fat, Snake bile , Snake bone, Snake oil, Snake shed skin, Zoo therapeutic application;*

INTRODUCTION

The biological resources are use in traditional and folk medicine since ancient times due to cost effectiveness, easy availability. Animal and its body parts is an important ingredient in traditional treatment (Alves and Alves 2011). World Health Organization (WHO) has estimated 80% of the global rural health population depends upon traditional medicine for their healthcare needs. In Latin America 584 species of animals are used in traditional medicinal practices (Alves *et al.*, 2007).

In India 15–20% of animal based products are used in Ayurveda, and 200 drugs from animal origin are used in the Unani medicinal system (Mahawar & Jaroli, 2008). In India, approximately 109 mammalian species are use for therapeutic purposes. Epidemiological survey regarding the use of animal products in treatment of various ailments states 38.5% are used in rheumatic and other pains, gastric problems (20.2 %), skin related problems (14.7%), impotency (18.4%,), aphrodisiac (14.7%) and contraception (11.5%) (Mahawar & Jaroli, 2007; Mahawar & Jaroli, 2008) (Table1).

Animals have been playing a significant role in healing processes, folk rituals, and religious practices of peoples globally. In traditional Chinese medicine more than 1500 animal species have been documented to be of some therapeutic use. More than half of the modern drugs are of biological sources and out of that, 252 (8.7%) chemicals are from animal sources (Chakravorty *et al.*, 2011).

India has wide bio- geographical variation including diverse flora and fauna, and different tribal and ethnic communities. This rich diversity of traditional life styles and biological resources in the different states has permitted gathering a wealth of ethno zoological knowledge.

Zoo Therapeutic use of Snake and its Body Parts in Folk and Traditional Medicine

Snake and its body parts are used in folk and traditional medicines globally lacking scientific evidence. Increase in ethno–ophiology studies are warranted in this field to establish the medicinal

properties of snakes and its body parts, which may give rise to drug development clues in the near future.

Table1. *Animals and body parts used by traditional medicinal practioners in India*

Common Names	Scientific Name	Parts Used	Indication	Prescription
Fish				
Eel	*Anguilla sp*	Mucus	Burns	Body mucus to be applied on burn areas of the body
Fresh water fishes	*Semiplotus sp., L. rohita*	Stomach, gut Cervical Vertebrae	Stomachache, digestive problems Urine problems	Intestines & stomach are smoked in fire, mixed with salt and taken with rice.
Gangetic goonch	*B. bagarius*	Fins, bone	Body burns, Stomach pain	Smoked dried bones/ fins are burnt to ash and applied on burnt portion.
Cat fish	*Amblyceps sp.*	Bones	Body burns	The cooked fish bones are burnt to ash and applied to the burn.
Ballitora minnow	*P. ballitora*	Whole body	Diarrhoea	Smoked, dried fish
Amphibian				
Frog	*Rana sp*	Whole body, skin, flesh	Wound healing	Live crushed frog is applied to wounds from insect bites
Reptiles				
Python	*Python molurus*	Body fats Meat Slough	Joint pain Rheumatic pain, toothache, Eye sight.	–
Cobra	*Naja sp.*	Flesh	colds, flues & urination, eyesight, foot & mouth disease	Cooked meat
Monitor lizard	*V. bengalensis*	Flesh, meat, fat skin, oil	Cough, fever, Promotes strength, joint & back pain, piles, arthritis	Flesh boiled
Birds				
Crow	*C. splendens*	Flesh, fat	Stomach disorder rheumatism, paralysis, ear ache, smallpox, malaria, leucoderma.	Dried meat, Cooked meat
Eagle	*S. cheela*	Fat , feathers, Oil	Burns, wounds, body sprains, typhoid, malaria	Oil applied topically
Mammal				
Mithun	*Bos frontalis*	Gall bladder, testicles.	Dysentery, Coughs, fever, Lactation	Gall bladder is filled with rice powder and tied properly and smoked
Goat	*C. hircus*	Gallbladder& front albone, meat, urine	Fever & early pregnancy pain, stomachache improve digestion, weakness, tuberculosis, asthma	Burnt frontal bone Gall bladder cooked with rice
porcupine gut	*Hystrix sp.*	Gall bladder, Stomach, meat intestines, flesh	Diarrhoea, gastritis, tuberculosis	Gall bladder, stomach and intestines are boiled and taken with rice boiled flesh

Snake Blood

The tribes of Bastar and Chattisgarh use cobra blood to increase sexual virility and performance (Joshi & Joshi, 2010). Snake blood is used in the treatment of rheumatoid arthritis, post–surgical infection, male impotency, near sightedness, baldness, restore olfactory sensation.

Lipids (myristic acid, palmitic acid and palmitoleic acid) in python blood play a crucial role in preventing accumulation of high levels of circulating lipids, triglycerides or fatty acids. The fatty acid transport and oxidation combined with increased expression and activity of the cardio protective enzymes viz. superoxide dismutase are upregulated by increasing expression of CD36, mFABP, CPT1, MCAD, and ACAA2 mRNA; protecting cardiomyocytes from apoptosis in the presence of palmitic acid. This occurs because palmitoleic acid combine with increased oxidative and free-radical scavenging capacity might act and reduce the generation of ceramide and reactive oxygen species resulting in the enhanced activity of cardio-protective pathways. Riquelme *et al.*, 2011 showed the cardio protective nature of snake blood by injecting mice with fed python plasma. Injected mice showed increase production of IGF-1 and fat metabolism.

A novel and a new cytotoxic factor isolated from the serum of the non–venomous African rock python (*Python sebae*) showed anti tumour activity in dose dependent manner in several cell lines. In a model of human squamous cell carcinoma xenograft (A431), subcutaneous injection of *P. sebae* serum reduced the tumour mass and volume by 20%. F5 a protein fraction isolated from the *P. sebae* serum reduced tumour cell viability in *in vitro* and in *in vivo* model (Donnini *et al.*, 2011). Cobra blood is a rich source of iron hence reduces fatigue (Table 2).

Snake Meat

The earliest records of using snakes for food come from the Tang Dynasty (618–907 A.D.) including the meat of pythons, pit vipers. Snake meat comes in various colours, depending upon the species of the snake and its diet. Pit viper (*Agkistrodon halys*) meats are use to treat skin diseases, pain, and intestinal hemorrhage. *Lacheis gramenius* flesh generally consumed with fermented rice drink to cure bone disorders and to augment appetite (Joshi & Joshi 2010). Snake meat is low in fat, calorie, and acts as rich source of protein helps to augment immune system. In traditional Chinese medicine, the snake meat is consider as a body warming food and is preferred during the winter season for its body warming effect. Snake meat contains protein necessary for development of muscles. Snake meat contains approximately 93 calories per 100g of raw meat, which varies depending upon the type and species of snake. Snake meat cure malaria, ease joint pain, wards off evil spirits. 200 patients consumed rattle snake meat for treatment of skin conditions (34%), arthritis (19%), stomach problems (14%), blood diseases (13%), cancer (12%), infections (12%), diabetes (12%), hypertension (4%); nervous conditions (3%), allergies (3%) and miscellaneous illnesses 13% (Bhatt *et al.*, 1988). In Mexico and in other Latin American countries, rattlesnake meat is sold as capsule to treat impotence and cancer. Rattle snake meat is dried grounded sprinkled into open wounds and body sores to heal them, rattle snake ointment is applied on aches and pain. Cooked meat of *Naja sp.* is use in treatment of colds, flues and epidemics. Raw meat of *Naja sp*. crushed with little salt and fed to cattle suffering from foot and mouth disease by the Galo tribes of Arunachal Pradesh. Snake meat increases eye sight and also facilitate urination (Chakravorty *et al.*, 2011) (Table 1 & 2).

Snake Fat

Traditional medicines use snake fat to cure impotency, paralysis (Joshi & Joshi 2010). *Boa constrictor* fat possesses anti-inflammatory and antimicrobial activity against *S. aureus* and *S. pyrogenes* organisms (Falodun *et al.*, 2008). Common rat snake fat is use to treat joint pain, cobra fat is use to treat migraine and bone disorders. *Python morulus* fat is use to treat rheumatic pain, burn wounds. *Boa constrictor* fat contains 62% unsaturated (palmitoleic acid, oleic acid, vaccenic acid, arachidonic acid, linoleic acid) and 38% of saturated fatty acids (myristic acid, palmitic acid, stearic acid), the unsaturated fatty acids can show antibacterial activity by modifying the endogenous synthesis of bacterial fatty acids (Ferreira *et al.*, 2011). In Lucanian medical folklore *Elaphe quatuorlineate* fat is generally extracted when the animal is still alive is use in external medical applications for rheumatism (Pieroni *et al.*, 2004). In traditional Indian medicine *P. tyasmucosus* fat is used in the treatment of joint pain. *Naja tripudians* and cobra fat is used in the management of excessive hair loss, topically applied on head to cure migraine and fractured bone. Topical application of *Eryx johni* or the black earth boa snake's fat is use to cure asthma (Joshi & Joshi 2010). In India cobra python, viper fats are used to cure tuberculosis, asthma, rheumatism, erectile dysfunction, joint pain. The fats are usually cooked and consumed or warmed and massaged externally or are stored in bamboo containers and are externally applied. Irular, Mudugar, Kurumber tribes of Western Ghat Kerala uses snake fat to treat rheumatic pain, toothache. Tribal populations of Tamil Nadu also practice the use snake fat in the treatment of leprosy (Chakravorty

et al., 2011). Rattle snake, *Boa sp*. and anaconda fat are use to treat rheumatoid arthritis (Gomes *et al.*, 2011). In Brazilian folk medicine *Crotalus durissus*, *Bothrop sleucurus*, *Lachesis muta Boa constrictor*, *Epicrates cenchria*, *Eunectes murinus fat* sare use in treatment of rheumatic pain, head ache, ear ache, sore throat, tooth ache, pain in the spine, furuncle, wounds, asthma, stings of insects, dogs bite, masculine impotence, tumour.

Snake Bile

Snake bile composed of cholic acid and chenodeoxycholic acid has long been valued for its medicinal properties characterized by its sweet after taste. The use of snake bile was first mentioned in the "The Transactions of Famous Physicians" compiled by Tao Hong in Chinese traditional medicine in and around 520 A.D. The snake bile is collected during the spring and summer when the solid contents are highest. The bile of a snake is mixed with some rice wine and is consumed before a meal to impart strength, vitality and appetite stimulant. Snake bile is use to treat whooping cough, rheumatic pain, high fever, infantile convulsion, hemiplegia, hemorrhoids, gum bleeding, and skin infections. Snake gall bladder is combined with pinellia or citrus to produce an antitussive and phlegm–resolving powder for treatment of acute bronchitis. Snake bile is obtain from sources such as *Naja naja atra*, *Bungarus fasciatus*, *Elaphe radiata*, *Ptyas korro*, and *Zaocys dhumnades*. In traditional Chinese medicine snake bile and several herbs are mixed together to treat chronic bronchitis and emphysema (Still, 2003). Snake gall bladder is use in the treatment of intestinal haemorrhage and skin infection. Snake bile obtained from *Hydrophis cyanocinctus* showed antitussive action in experimental animal model. She Dan Chuan Bei San a traditional Chinese medicine whose English name corresponds to "Three Snake Gall Fritillaria Eriobotrya" and comprises of fritillary extract 750mg, apricot kernel extract 300 mg, water, snake bile extract, ascorbic acid and natural flavours. It is used in the treatment of reduce the amount of voluntary behaviour, extend convulsion, strychnine poisoning, cough, pharyngitis, bronchitis, inflammation of upper respiratory tract, infantile pneumonia, sepsis, pain, ulceration, vaginal and uterine bleeding.

Though used extensively in traditional medicine but it increases GOT, GPT, BUN, creatinine even can cause mortality in a dose dependent manner (Hwang *et al.*, 1996). Yeh *et al.*, 2003 used a synthetic bile acid mixture mimicked the bile acid composition of a snake *Naja naja atra* bile juice. After exposure, experimental rats showed increase comparative ratios of liver and kidney mass to body mass, increase in the level of AST, ALT, ALP, plasma urea nitrogen and creatinine. Histopathological studies of liver and kidney also showed cell enlargement and lesion in cell integrity in treated groups. The study indicated short-term toxicity of snake *Naja naja atra* bile acids.

Snake Venom

The snake venom is the only component of snakes that has been extensively studied for its structure function diversity, and fascinating mechanism of action but it still remains a mystery to the entire scientific fraternity of toxinologists globally. Snake venom is a complex mixture of various proteins, peptides, and polypeptides targets the neuromuscular and circulatory system (Kini, 2006). In Indian traditional medicine snake venom is use to treat diseases like arthritis, bone and joint disorders. In the folk medicine, poisonous snakes are allow to bite the patients suffering from diabetes. The first Angiotensin converting enzyme inhibitor "captopril" was identify from the venom *Bothrops jararaca*. Several protein peptides have been isolated from snake venom, which shows potent activities. PLA_2's from *Bothrops neweidii*, *Naja naja* and *Crotalus durissus* venom, found to be cytotoxic (Basavarajappa & Gowda 1992; Cura *et al.*, 2002). *Trimeresurus flavoridis* possessed anti– myotoxic, anti–edematogenic, anti–cytotoxic, and anti–bactericidal activities and are therefore, used in the treatment of neurodegenerative disorders such as Alzheimer's disease, Parkinsonism (Farooqui *et al.*, 1999). Neurotoxins isolated from cobra triggers central cholinergic pathways through nicotinic agonists in turn stimulate anti–nociceptive effects prompting analgesic effect (Damaj *et al.*, 2000, Decker *et al.*, 2001). Fibrolase isolated from *A. contorix* venom degrade α and β fibrin chains and used as a thrombolytic agent (Samsa *et al.*, 2002). Meenakshisundaram *et al.*, 2009 have proposed that L– amino oxidase (LAO) and phospholipase A_2 (PLA_2) from snake venom exert effect on membrane protein and/ or act against HIV at multiple levels or cells carrying HIV virus. This resulted in an enhanced effect of anti-retroviral therapy (ART) thereby decreasing viral potential.

Indian monocellate cobra (*Naja kaouthia*) venom (NKV) showed anti-arthritic activity over FCA

induced arthritis in male albino rats (Gomes *et al.*, 2010). Research in this field is going on very fast pace and it is continuously providing new drug clues for the near future (Table 2).

Snake Bone

Snake bones are use by traditional practioners to treat diseases like gangrene, burns, infection, malaria, dengue fever, cancer, AIDS and to boost the immune system. Tail bone of snake is worn by the tribes of Bastar, Chattisgarh district of India to ward off the evil spirit (Joshi & Joshi, 2010). Ancient Mayan culture use snake bone to prepare a medicine known as "Cascabel" to treat various ailments. Snake bones are used as amulets to cure toothache. The Native American communities residing in parts of Latin America uses the vertebral bone of rattle snakes for young children who are teething, believing that the bones avert teething pain. In Slovenian folklore rheumatic pain are treated with snake bone. This primitive mode of treatment involves placing a dead snake into a box with holes, and the box on an ant hill. When the ants pick bones, it is thrown on coals, and the rag is first held above the coals, and then placed upon the afflicted body part. In the traditional Chinese medicine snake bone capsules are marketed, its trade name is "SHE WANG BU, Snake Bone Rheumatism Capsule". Snake bone is use in expelling wind and removing dampness, relaxing muscles and activating body channels, relieving swells and stopping pains, strengthening the muscle and bones. It is also used in relieving rheumatic bone pain, swell and pains of the joints, arthritis, gonarthritis, sciatica, tetraplegia, lumbar muscle strain, prolonged rheumatism, pains caused by hyperosteogeny and spurs. Rattle snake bone is use in children with weakness, by mixing it in the water during bathing; it is even believed that bones could induce spiritual power in human. The head of viper is sometimes were used for the treatment of snakebite as a part of traditional medicine, it is applied by making a concoction with some herbs as a traditional medicinal remedy (Table 2).

Snake Shed Skin

Skin shedding or ecdysis, is a dynamic function that occurs through the lifetime of snakes. Healthy snakes shed their skin in a single piece three to four times a year. The frequency of shedding depends on various factors viz. age, nutritional status, climate condition, reproductive status etc. The shedded skins are a treasure house of bioactive molecules and have been used in folk & traditional medicinal system (acne, carbuncle, psoriasis, glaucoma, eczema etc). Indian traditional healers use the ash of shed snake skin in inducing labour contraction. Powdered whole rattlesnakes (the skin and the rattles) are used in Latin American folk-medicine to treat eczema and boils. The dried and powdered rattle snake skin are sprinkled on food or alternatively, use the powder to make a poultice and apply directly to the skin. In the African-American hoodoo tradition, powder snake skin either from sheds is an important ingredient of Goofer dust. Goofer dust are grave yard dirt, powdered sulphur, red pepper, black pepper, mullein, and a variety of other herbs and the myth associated with is that it has the capability to ward off trouble, mess up, or even kill one's enemies. During 1920's–1930's in traditional Chinese medicine dried black snake skin are marketed in the name of Wus Shao She for treatment of arthritis, pain and joint stiffness. Snake shed skin are boiled and are mixed with herbs to make a decoction for the treatment of convulsions due to tetanus and skin diseases especially eczema (Table 2 & 3). Mukherjee *et al.*, 2013 for the first time established the inhibitory role of snake shed skin on estrous cycle in female mice. It caused cessation of estrous at diestrous phase. NNSS2 a peptide was isolated from *Naja naja* shedded skin that

Snake Oil

Snake oil is mention in Chinese folk medicine for treatment of joint pain, arthritis and bursitis. Snake oil made from the preparation of Water Snake (*Enhydris chinensis*) in Chinese medicine is use to treat joint pain. Several tribes from Indian subcontinent like Nahuatl use Rattle snake oil for making hair to grow longer and to treat rheumatism. Chinese traditional medicinal practitioners use snake oil to reduce blood pressures, skin rashes, eczema and cardiac condition. Chinese water snake oil is used by traditional medicinal practitioners to treat hyper tryglyceridemia. Snake oil had high source of eicosapentaenoic acid and act as a potential inflammatory agent. Datubo–Brown & Blight 1990 for the first time reported the presence cytotoxic activity in the snake oil. They scientifically established that the oil from *Boa constrictor* had growth inhibitory activity on human fibroblast: both keloid and normal dermal fibroblasts in *in vitro* model. They postulated that the fatty acids are the major ingredients present in the snake oil that caused the inhibition of the fibroblasts (Table 2).

probably is responsible for the estrous cycle inhibition (Mukherjee *et al.*, 2016).

Table2. *Global use of Snake and Body Parts in Traditional Medicinal System*

Snake (Common Name/ Scientific Name)	**Body Part/ Secretion**	**Condition**	**Country of Origin**
Cobra	Blood	Increase sexual virility	India (Bastar & Chhattisgarh)
Rat Snake	Blood	Arthritis	India
Unknown	Blood	Posts–surgical complications, Male impotency	India
Burmese Python	Plasma	Cardio–protective activity	Unknown
African Rock python	Serum	Anti–tumour activity	African
Cobra	Blood	Fatigue, Replenished human blood	China
Unknown	Blood	Asthma, Eczema, skin nourishing activity, near sightedness, baldness, restoration of olfactory sensation.	Jakarta
Pit Viper	Meat	Skin disease, pain, intestinal heamorrhage.	China
Lacheis gramenius	Meat	Bone disorder, augment apetite.	India
Rattle Snake *Naja sp.*	Meat Meat	Obesity, hypertension, wound healing, nervous breakdown, allergy, diabetes, impotency Cold flues, epidemics, foot and mouth disease of cattle, urination, eye sight improvement.	China India
Boa constrictor	Fat	Anti-inflammatory, antimicrobial	Unknown
Rat Snake	Fat	Joint pain, migrane, bone	India
Python morulus	Fat	Impotency, paralysis	India
Elaphe quatuorlineata	Fat	Rheumatism	Europe
Ptyas morulus	Fat	Joint pain	India
Naja tripudian	Fat	Prevent excessive hair loss, migraine, fractured bone	India
Cobra	Fat	Prevent excessive hair loss, migraine, fractured bone	India
Eryx johnii *Python morulus*	Fat Fat	Asthma rheumatism, erectile dysfunction Joint pain	India India
Unknown *Crotalus durissus* *Boa sp.* Anaconda *Boa constrictor* *C. durissus* *B. sleucurus , L. muta, B. constrictor , E. cenchria, Rainbow boa* *E.murinus Naja naja atra, B. fasciatus, E. radiata, P. korro, Z. dhumnades*	Fat Fat Fat Fat Fat Fat Bile	Rheumatic pain Rheumatic pain Pain Pain Rheumatic pain Pain, head ache, furuncle, wound, stings, male impotency Whooping cough, rheumatic pain, high fever, convulsion, hemiplegia, hemorrhoids, gum bleeding, skin infections. Antitusive action	India India India Brazil
Cobra	Venom	Arthritis, joint pain	India
Viper, cobra, *Crotalus sp., L. mutus*	Venom	Skin disorders, bed sores, boils, gall stones, gums, bleeding, head ache, hemorrhoids, menopause	India
Rattle Snake	Bone	Weakness	Slovenia
Unknown	Bone	gangrene, burns, infection, malaria, dengue, cancer, AIDS	India

Unknown *Enhydris chinensis*	Bone Oil	Rheumatic bone pain, swell and pains of the joints, peri arthritis of shoulder, gonarthritis, sciatica, tetraplegia, lumbar muscle strain, Joint pain	China China
Ratlle snake	Oil	Rheumatic pain	India
Cobra	Shed skin	Labour induction	India
Rattle snake	Rattle & shed	Eetanus , eczema	India
Unknown	skin Shed skin	Glaucoma, psoriasis	China

Table3. *Snake and its body parts us as traditional medicine*

Snake	Parts Used	Disease
(Unknown)	Gall bladder	Constipation, Eye diseases, Liver problem,
(Unknown)	Snake powder	Stomach and intestinal problems, blood purifiers
Pit viper (*A. halys*)	Meat	skin diseases, pain, and intestinal haemorrhage http://www.itmonline.org/arts/snakes.htm
Sea Krait-	Snake power	Bi syndrome and painful arthritic conditions. http://nuherbs.com/resources/snakes
Pit Viper	Snake power	Bi syndrome and painful arthritic conditions. http://nuherbs.com/resources/snakes
Rat Snake	Snake power	Bi syndrome and painful arthritic conditions. http://nuherbs.com/resources/snakes
Rattlesnake	Snake power	Bi syndrome and painful arthritic conditions. http://nuherbs.com/resources/snakes
B. parvus	Unknown	To dispel wind, to remove obstruction of the collaterals, and to relieve spasm http://en.wikibooks.org/wiki/Traditional_Chinese_Medicine/Usage_Of_Single_Herbs
P. serpentis	Snake skin	To arrest convulsions, to counteract toxicity, and to clear the eye of corneal opacity http://en.wikibooks.org/wiki/Traditional_Chinese_Medicine/Usage_Of_Single_Herbs
Black tail snake	Unknown	To dispel wind, remove obstruction of the collaterals, and relieve spasms and convulsions http://en.wikibooks.org/wiki/Traditional_Chinese_Medicine/Usage_Of_Single_Herbs
Agkistrodon sp.	Alcoholic extract Ash of shed skin	Arthritis, stiffness of the joint, mammary abscess and tumor, boils, carbuncles, and furuncles. Mammary abscess ,tumour, boils, carbuncles, and furuncles http://www.itmonline.org/arts/snakes.htm
Unknown	Snake shed skin	Chronic skin disorder including acne, carbuncles, itching skin, and psoriasis, glaucoma http://www.itmonline.org/arts/snakes.htm
Unknown	Bile	Whooping cough, rheumatic pain, high fever, infantile convulsion, hemiplegia, hemorrhoids, gum bleeding, and skin infections. http://www.itmonline.org/arts/snakes.htm

CONCLUSION

Snakes and its body parts have been used in the treatment of various ailments traditionally, especially in the traditional Chinese medicine (TCM) and even in the ancient Indian medicine. Despite its recurrent occurrence in folk and traditional literature, research on this aspect is neglected. The scarcity of scientific knowledge regarding the zoo therapeutic products is basis on which new comers are attracted to work in this unexplored arena. More ethno–ophiology both in the aspect of conservation and therapeutics are warranted to establish the zoo therapeutic use of snakes and its body parts, which may give rise to drug development clues in the near future.

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