JOJ Wildlife and Biodiversity

Juniper Publishers
key to the Researchers

Mini Review
Volume 3 Issue 2- January 2021

JOJ Wildl Biodivers

Animal Venoms

Fidelis Bekeh Ada[1], Sunday, Kenneth Igbang[2] and Ugbong and Emmanuel Akomaye[3]

[1]*Department of Fisheries and Aquatic Science, Cross River University of Technology, Nigeria*

[2]*Department of Fisheries and Aquaculture, Faculty of Oceanography, University of Calabar, Nigeria*

[3]*Department of Forestry and Wildlife Resources Management, Faculty of Agriculture, University of Calabar, Nigeria*

Submission: October 21,2020; **Published:** January 05, 2021

***Corresponding author:** Fidelis Bekeh Ada, Department of Fisheries and Aquatic Science, Cross River University of Technology, Obubra Campus, Cross River State, Nigeria

Abstract

Venoms are poisons or toxins of animal origin in which the animal that produce the toxins are capable of introducing the toxins into the body of the victims. Animals that produce toxins but lack the ability to introduce the toxins into their victims are said to be poisonous animals. Venoms are classified based on their site of action in the bodies of their victims. Thus, they classified into ...; and based on the type of animal producing the venom, it is difficult to classify venom based chemical constitution because of the fact that particular venom is highly complex chemically with many reactive sites. The role venoms play on organisms in the environment is highlighted.

Keywords: Venoms; Poisons; Envenomation; Victim; Prey; Predator; Role of venoms

Introduction

In order to fully understand what venoms are, one has to know what poisons are. This is because venom is a group of poisons. Poison is a substance that has ability to cause physiological damages to organism(s) at very low concentrations. Perry and Earl defined poison as a substance which by chemical actions and at low dosages can causes injury or even death to living, meaning that 18 mg of this can kill 100,000 persons organism(s). It has also been noted that all substances could be poison when exposed to organisms beyond certain concentrations and time limit [1-4]. For example, antibiotics such as penicillin, although not toxic to mammals at low concentrations is poisonous to bacteria. In common usage, the word poison is limited to substances that are toxic to man and other mammals. The following illustration demonstrates the definition of poisons. Nearly all substances become poisonous at more than required concentrations when taken by organisms. A substance that does not have injurious or lethal effects at very low concentration therefore is not a poison. This is supported by the discovery by [5] that 180g of Clostritium botulinum toxin is potent enough to kill 1000 million people.

A poison originating from living things (plants and animals) is called a toxin. And toxins produced by animals are referred to as venoms when there exists an organ of instrumentation. Venoms are complex mixture of substances that are pharmacologically highly active and can cause symptoms in victims. Venom is, therefore, a poison which is produced by an animal directly into the body of the victim. From here, it is understood that venoms are synthesized by the venomous animals itself. So, not all poisons produced by animals qualify as venoms. A toxin is qualified as venom when the animal producing the toxin has an apparatus that can introduce it to the victim's body [6]. This could be in cases of animals like snakes and some fishes. Some animals are usually blessed with venomous glands. but in unicellular animals, Poisons are produced by certain organelles of the cells such as is found in the cell wall of endotoxin producing protists. Venoms could also be called zootoxins. Though all poisons produced by animals are called zootoxins or venoms. It is really confirmed as venom if the animal producing it is the one which injects it into the victim. If the animal which injects it into the victim is different from that which produces it, the toxin is simply described as poison (Figure 1). For example, it is wrong to describe a rabid dog as venomous since it only transmits toxin in rabies virus. The expression of venoms at very low concentration is as a result of the fact that they are proteins. Thus, they are enzymic in action.

Types of Venoms

No comprehensive classification of venoms now exists. Knowledge of the chemical composition of venoms at present is not consistent enough to permit the adoption of a single working classification scheme. So far, venoms have been loosely classified

according to their mode of attack as well as the type of animal that produce the venom. Based on their site of attack, they are classified into local, auto pharmacological, antiheamostatic, neurological, muscular, cardiac and renal effects [7,8]. One venom may fall into more than one of the above classes because of their complex chemical composition. A local venom is that which does not move away from the site which is introduced. Poisons that behave like that are usually very potent. If the cells in contact with poisonous are damaged, then the transport of the venom to other locations become difficult. This is exemplified in herbicides which are contact poison like paraquat [9].

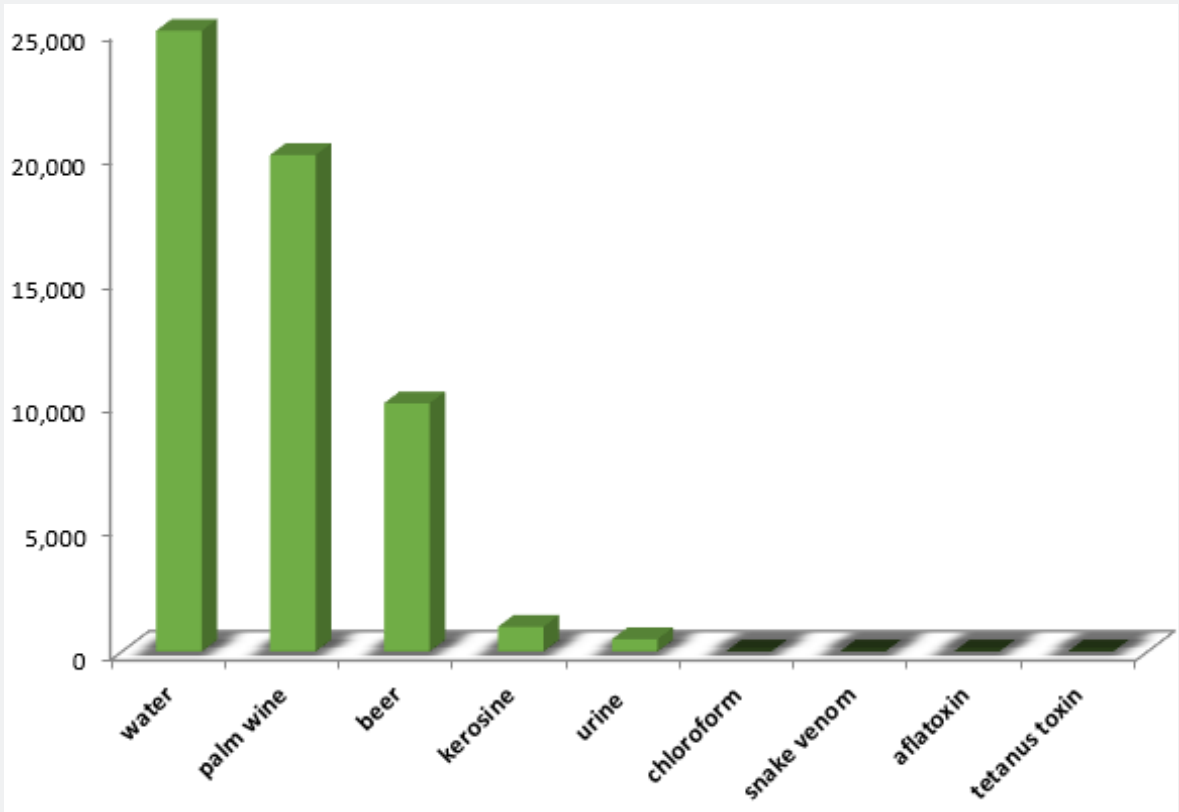

Figure 1: showing the relative concentrations of substances taken by man at a limited time to be able to confer morbidity and mortality to man. Only those that are toxic at very low concentrations are said to be poison.

Venoms that are ethnopharmacological lead to extravasation of circulatory fluids and hypovolemic shock and other features resembling type, hypersensitivity reactions [10]. Renal failure in venom infection is caused by hypotension and shock [11]. Many types of venom that have muscular effects could cause the dissolution of muscles; a process known as myolysis. Rabdomyolysis is common in envenomation by sea snakes. The early sign are muscular pains, tenderness followed by placid paralysis and renal failure [12]. Antiheamostatic venoms disrupt the normal functions of blood. These include inability to clot or coagulate. It may even lead to hemolysis; the reason why patients may oose blood from openings such as nose and ears in snake bites like bambas Lunganss & Bodio.

Based on the organism, which produces the venom, Utkin, [8] pointed that a wide variety of animal taxa produce venoms. Therefore, the venoms are named according to the animal producing it. The following groups of animals as shown on (Table 1) are capable of producing venoms. Before now, amphibians especially Anurans were not counted among the venomous animals. Frogs were only noted for producing poisons in poisonous glands without the ducts to carry them to victims. Since these glands lack the instruments for inoculations, the animals were merely described as poisonous animals and the glands called poison glands [13]. Some species of frogs have now been identified as venomous frogs and their venoms have potency of 25 times higher than that of pit viper e.g., Aparasphenodon bruno Bruno casque-headed frog [14] estimated that venom of Corythomantis greening (Greening's frog) is two times more potent than that of pit viper. And one gram of the venoms of Bruno casque-headed frog can kill 300,000 mice or 80 humans. These frogs live in the tropical rain forest of Brazil. They have spines on their heads which they used to inoculate the venom into the victim. The

How to cite this article: Fidelis B A, S, Kenneth I, Ugbong, Emmanuel A. Animal Venoms. JOJ Wildl Biodivers. 2021: 3(2): 555611

venoms of these frogs are so portent that hunters use them to poison their arrows to kill animals during hunting. Hunters pierce the arrows through the frogs causing it to twist and secrete poison on the arrow. Or the frog may be pierced and kept over a fire. The heat causes the frog to secrete droplets of poison that is collected in jugs. One small size frog can produce poison that can poison 50 arrows as was pointed out by [15]. These poisons are reported to remain active for over a period of one year [16]. With the poisons, a small wound/ulcer created by the arrow could lead to the death of victim. Members of the class of amphibians called Caecilians that are snakelike are venomous and can give bites similar to that of snakes [17]. Caecilians are blind, limbless amphibians that burrow into the soil. These are abundant in the rain forest of Cross River State of Nigeria especially in northern part of the state [17-20] noted that they exist in Africa, Asia and America.

Table 1: Anima taxa containing venomous animals, mechanisms of envenomation and some symptoms.

Animal taxon	Habitat	Example	Mode of envenomation	Symptoms
Coelenterarata	Aquatic	Hydra, Corals, Jelly fish (Pelogia noctiluca), Anemones (Portuguese man o' war)	Nematocysts with harpoons peneteate skin surface and release venom	Skin burning sensation and sometimes systemic envenomation
Hexapoda 6-legged animal)	Terrestrial	Nearly all hymenopterans such as wasps, ants and bees.	Sting apparatus connected to venom gland, though some ants lack sting so they squart their venoms. Sting of bee get detached from bee and continue to pump venom to victim afterwards	Allergic reaction, sting around the throat is more dangerous. Hypovolema, myolysis, heamolysis, neurological disturbance and renal failure which may lead to death
Octopoda (eight-legged animal)	Terrestrial	Scorpio	Sting at the end of slender tail.	intensive and local pains, abdominal cramps, Sweating, hypersalivation, vomiting, bradycardia and arterial hypertension and may to cardiac failure.
Arachnida (eight legged animals) spiders. Arachnida	Terrestrial	Bird spider, widow spider, banana spider (can be carried to new places in banana bunches)	Venom jaws connected to venom glands. May be too weak or small to penetrate human skin	arterial hypertension/hypotension, massive release of neurotransmitters, Local erythromateous edema, necrotic lesions known as necrotic arachneism, death
Myriapoda	Terrestrial	Centipede, and even millipedes, though millipedes have no organ of poison administration	ozopores in millipedes, centipedes inject venom to victim through the modified first pair of their legs, which are connected to poison glands	poison from millipedes contain HCl acid, phenols, cyanides and quinones that cause burning of skin. ocular exposure can lead to blindness. bites from, centipedes cause intense pains, headache malaise, anxiety and dizziness.
Mollusca	Terrestrial	Conus species	Venomous apparatus made of radula, chiten linked to venom gland	Blockage of nerve impulse, muscular paralysis and death
Fish/pisces	Aquatic	Conus geographus, octopus (Hapalochaena sp), terebra sp (looks like periwinkle we eat)	Radula with few teeth modified to form harpoons that can inject venoms	Blockade of nerve impulse, muscular paralysis and death
	Aquatic	Sting ray, rabbit fish, scorpion fish, signus fish, surgeon fish, toad fish, weever fish, Clarias macrocephalus	Sharp spines on the dorsal and pelvic fins	Severe pains and sometimes death
Amphibia	Terrestrial	Corythomantis greening (Greening's frog) and Aparasphenodon bruno (Bruno casque-headed frog and Caecilians	Bites from caecilians and head spines from greening's and Bruno fro	Frog venom 25 times more potent than viper snake
Reptilia	Terrestrial	Dendrapis anguisticeps (the green bamba)	Venom injection using fangs situated in the upper jaw. Some snakes have no fangs and cannot inject appreciable quantity of venom	Auto pharmacological effects, hypotention leading to renal failure, extravasation of circulatory fluid, corneal ulceration and perforation when cobra spit on eye.
	Aquatic	Enhydrina schitosa, Hydrophis cyanocinctus	Injection of venoms, bite marks may not visible	Rhabdomyolysis, muscular pains and tenderness, paralysis and renal failure

How to cite this article: Fidelis B A, S, Kenneth I, Ugbong, Emmanuel A. Animal Venoms. JOJ Wildl Biodivers. 2021: 3(2): 555611

Envenomation may have evolved in animals that too slow to be able to run after their prey. Slow moving pulmonated snails of the genus Conus are noted for their venoms with high potencies. Their radulae have been modified an organ for introducing venoms into victims. The conus snails are also found in the marine environment and there are records of envenomations by Conus geographus in Brazil [16]. Importance of venoms

Venom as any other thing has contributed both positively and negatively to life. A few of these are outlined here with:

Uses

i. **Population and biological control:** venomous animals are a source of death to a lot of other animals. This has about three types of resulting effects on the prey population. For instance, the prey population could be eliminated. It could be prevented from over running its natural resources. In which case, it is regulatory. Lastly, it could have no effect on the prey population. Taking lizards and snake relationship as a classical example, we can see how venomous animals affect the population of their prey. Where snake population is low, the lizard population would be high. Lizards take the advantage of the snakes' absence and become overpopulated as compared to elsewhere. As a biological control, venomous animals could be introduced into an environment where an unwanted species exist provided the venomous animal is selective on that species. Thus, snakes could be used to control rodents which are pest of many farm produce.

ii. **Food acquisition:** venoms are said to be modified saliva and enzymes. Venoms of snakes when injected into man, digestion start externally. The body starts to decay (dissolve) when the victim is still alive. Usually, either the blood or the nervous system or the muscle fibre or all of the above are affected. The resulting effect is that the victim becomes paralyzed for easy swallowing by the predator. This is advantageous in the snakes because they do not have chewing apparatus. As it was shown by Lassic in 1981 that venoms have form as a result of a continuous evolution from a serine protease to proinolin and lastly to toxic proteins.

iii. **Defense:** as it is known, some animals prey on others. Sluggish animals like snake, catfish, gila monster etc. have evolve a mechanism through which they could be protected. Thus, any living organism that knows about the dangers of the venoms will not dare pursue venomous animals. Example, the small insect papa *(Peaderus sabeaus)* which secretes toxin is feared by both man and other insect eaters such as lizards and birds. Other insects have turned to mimic the papa in coloration because of its defensive efficiency. Colour mimicry is equally observed in many animals as in tree frogs [16].

iv. **Medical uses:** Interestingly 'physicians in the early times used puffer toxin to treat sciatica and the poison of the newt to cure stupidity' [20]. Also, venoms of lower animals contain alkaloid substances which could be used in drugs making. It should also be noted that some venoms could be used in composing anti-venoms for other venoms. Toxins from spiders, scorpions, snakes, frogs, and fishes are therefore not mere curiosities but valuable tools for research on the molecular mechanisms of neural function and synaptic transmission [21]. Enzymes from pit viper venom and some other snakes were isolated [22]. Two of these enzymes were highly purified and are now used as valuable tools in anticoagulant therapy.

v. Venoms especially those from snake have been used in diagnosis of hemostatic disorders. A biological sealant was developed in Brazil by a group of researchers from the Center for the study of venoms and venomous animals [7]. Hypertension drugs like Enapril or Captopril is developed from pit viper Batrops jararaca. Eptifibatide is a drug that prevents heart attack. It is produced from a south eastern pygmy rattle snake [7].

vi. **Hunting device:** tree frogs produce poisons that are so potent that the Columbians use it to poison their arrows. The slightest penetration of the arrow emits/releases poison into the body that makes the animal morbid for easy capture or even causing mortality directly. These poisons have been used in Africa as weapon during tribal wars before the emergence of gun fire.

Detriments:

i. Venomous animals have caused a lot of troubles and fears to man and other animals with their venoms. Parker observed in 1977 that 'the number of deaths caused by fear within snake victims is higher than that caused by the venom itself'. Most death resulting from encounters with snakes are not necessarily caused by snake bites [23]. found that 62% of the people that died in Italy did not show any symptomatology of evonomation at all. In his study based on 292 Italian hospitals with first aid stations, he observed that out of the 2,329 people bitten by snakes, only three cases were fatal, 885 people showed signs and symptoms of envenomation while the rest 1,444 were not envenomated. Although deaths from habu snakes are relatively rare, the injuries caused by the venoms are always serious with extensive tissue damage in nature, so it is greatly feared and thus constitutes a significant problem for victims

ii. Water snakes have disturbed a lot of economic activities in the aquatic environment. One thing common about them is that they attack persistently and relentlessly. The fear for snake has gone a long way to deter agricultural activities. Observations on land snake, habu (Trimeresurus flavoviridis) by Tomari in 1987 show that farming activities is highly disturbed by this snake. Most of the occurrences of snake bite are during farming season and are especially are males. This is because men work in the farm than their women [24]. therefore, found that there was a significant positive correlation between habu bite, and the time spent in the sugar cane fields. This was buttressed by the findings of [18] that snake bite in Italy is at the peak during month of august when people are on holidays. Thus, people spend holidays on the countryside. He argued that this peak of snake bite is not as a

How to cite this article: Fidelis B A, S, Kenneth I, Ugbong, Emmanuel A. Animal Venoms. JOJ Wildl Biodivers. 2021: 3(2): 555611

result of increase in snake activities which is during March to June. He explained that the greater number of victims from Tokun is as a result of the fact that they have much larger farms and Amani, and the greater number of bites occurs during the month of June when farm activities are on the increase.

iii. Other venomous animals such as scorpions, the gila monster – a reptile, bees etc. have led to a good number of untimely deaths in both man and other animals. It has been roughly estimated that at least 40,000 people die every year from snake bite alone. These include both terrestrial and aquatic snakes [25].

Summary and conclusion

Venoms are produced by animals as poison. These animals must have the means of introducing the poison into the bodies of their victims [26-30]. Animals that produce toxins but cannot introduce them to the bodies of their victims are described as poisonous animals. All phayla of animals do have representatives that produce venoms. Some venomous animals derived their poisons from their diets such as in arrow poison frog. As it is so with everything, venoms have positive and negative influence in the environment. The positive influence includes, population and biological control, food acquisition, defense, therapeutically uses, medicinal use as in diagnosis of hemostatic disorders and hunting device; while the negative influence include causing of troubles and fears to man and other animals with their venoms, disturbance and cause of untimely death to humans. Most of death recorded as being caused by snake venom is due to fright of and not necessarily the chemical or physiological manipulations of the venom in the bodies of the victims.

References

1. Jouncey K, Ross B (1982) A Guide to Tilapia Feeds Feeding. Institute of Aquaculture, University of Stirling, Scotland, UK. 111PP.
2. Ross MA, Childs DJ (1996) Herbicide mode-of-action.
3. Ogundele O, Ihuahi JA, Omojowo FS Bitrus P (2004) Toxicity of Linear Alkynbenzene Sulphonate (LAS) Detergent of Clarias girepinus Fingerlings. In. the proceedings of the 19th Annual Conference of the Fisheries Society of Nigeria. 273–276.
4. Wike University (2010) Artrizine in Drinking Water and Drinkig Water testing Evaluation Programae, Center for Environmental Quality at Wike University.
5. Laminna C (1959) The most poisonous poison. Science 130: 763-772.
6. Oterloff E (2020) Can frogs be venomous. Natural History museum.
7. Utkin YN, (2015) Animal venom studies: Current benefits and future developments. World J Biol Chem 6(2): 28-33.
8. Junghanss T, Bodio M (2020) Medically Important Venomous Animals: Biology, Prevention, First Aid, and Clinical Management In Charles D. Ericsson and Christoph Hatz, (Eds) pp. 1309–1317.
9. Ada FB, Ekpenyong E, Ayotunde EO (2011) Hematological, behavioural and biological changes in Oreochromis niloticus juveniles exposed to Paraquat Journal of Environmental Chemistry and Ecotoxicology 4(3): 64-74.
10. Warrell DA (2003) Injuries, envenoming, poisoning, and allergic reactions caused by animals. In: Warrell DA, Cox TM, Firth JD, eds. Oxford Textbook of Medicine. 4th ed. Vol 1. Oxford: Oxford University Press: 923-946.
11. Sutherland SK, Tibballs J (2001) Australian animal toxins: the creatures, their toxins and care of the poisoned patient. 2nd ed. Melbourne: Oxford University Press,
12. Reid HA (1975) Epidemiology and clinical aspects of sea snakes' bites. In: Dunson WA, ed. The biology of sea snakes. J Trop Med Hyg 78(5):106-113.
13. Achyuthan VS, Sunagar SS (2018) Animal venoms origin, diversity and evolution.
14. Sekar S (2015) This venomous frog has killer spines on its head
15. SeaWorld Park (2020) Poison arrow frogs. SeaWorld Park and Entertainment.
16. Gruber K (2015) Poison dart frogs are the most poisonous animals alive.
17. Choi CQ (2020) Legless amphibians have snakelike venomous bites. Inside science.
18. Pozio E (1988) Venomous snake bite in Italy: epidemiological and clinical aspects. Tropical medicine and parasitology 39(1): 62-66.
19. Tomari T (1987) An epidemiological study of the occurrence of Habu snake bite Amami Islands, Japan Int J Epidemiol 16(3): 451-461.
20. Read DE (1939) Chinese Metria Mwdica: Fish drugs. Natural historical bulletin; Peking. P. 136.
21. Kalia J, Milescu M, Salvatierra J, Wagner J, Klint JK, King GF, Olivera BM, Bosmans F (2015) From foe to friend: using animal toxins to investigate ion channel function. Journal of Molecular Biology 427: 158-175.
22. Chang CC, Lee CY (1963) Isolation of neurotoxins from the venom of bungarus multicinctus and their modes of neuromuscular blocking action. Arch Int Pharmacodyn Ther 144: 241-257.
23. Dunson A (1975) Adaptations of sea snakes; the biology of sea snakes. University Park press. London.
24. Ada FB (2001) Practical Biology for Colleges O-konelle Ventures Nig. Ltd. Calabar, Nigeria.
25. Haddad V, Amorim PCH, Haddad WT, Cardoso JLC (2015) Venomous and poisonous arthropods: identification, clinical manifestations of envenomation, and treatments used in human injuries Revista da Sociedade Brasileira de Medicina Tropical 48(6):650-657.
26. Haddad V, Cardoso JL, Lupi O, Tyring SK (2012) Tropical dermatology: venomous arthropods and human skin: part II: Diplopoda, Chilopoda and Arachnida. J Am Acad Dermatol67:347 e1-9.
27. Hermitte LCD (1946) Venomous marine mollusks of the genus Conus. Trans R Soc Trop Med Hyg 39: 485-486.
28. VH Neto JBP, Cobo VJ (2006) Venomous mollusks: the risks of human accidents by Conus snails (Gastropoda: Conidae) in Brazil. Revista da Sociedade Brasileira de Medicina Tropical 39(5):498-500.
29. Lima CA J, Cardoso JLC, Magela A, Oliveira FGM, Talhari S, (2010) Exogenous pigmentation in toes feigning ischemia of the extremities: a diagnostic challenge brought by arthropods of the Diplopoda Class ("millipedes"). A Bras Dermatol 85(3): 391-392.
30. Mongabay (2020) Dangerous fish and mollusks. Safety/survival/armyfieldmanuals/AFM 3-05 70.

How to cite this article: Fidelis B A, S, Kenneth I, Ugbong, Emmanuel A. Animal Venoms. JOJ Wildl Biodivers. 2021: 3(2): 555611