

# The Toxins That Are Designed to Kill – Or Heal

It's one of nature's great paradoxes. Humans generally take great pains to avoid these powerful critter toxins, yet researchers are now discovering that many can be harnessed to provide potent healing for chronic pain, hearty conditions, and even diabetes.

Reviewed by Dr. Becker

## STORY AT-A-GLANCE

- There are potentially 20 million distinct venom toxins, each with its own biological targets and effects that could help fight disease, relieve pain, and more
- To date, fewer than 1,000 venom toxins have been analyzed by scientists
- Toxins in snake, spider, centipede, and other species' venom have shown promise for treating chronic pain, heart conditions, blood clots, type 2 diabetes, and more

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Venom is one of nature's great paradoxes. At its most basic level it's designed to kill — and to do so quickly and efficiently. Yet, the same properties that make it deadly can also be harnessed to provide potent healing.

There are potentially 20 million distinct venom toxins, each with its own targets and effects that have yet to be explored. As National Geographic reported:<sup>1</sup>

*"Venom is exquisitely honed to stop a body in its tracks. The complex soup swirls with toxic proteins and peptides — short strings of amino acids similar to proteins. The molecules may have different targets and effects, but they work synergistically for the mightiest punch.*

*Some go for the nervous system, paralyzing by blocking messages between nerves and muscle. Some eat away at molecules so that cells and tissues collapse. Venom can kill by clotting blood and stopping the heart or by preventing clotting and triggering a killer bleed."*

What's intriguing is that venom often targets the same molecules that medicines target to treat disease, "fitting into them like keys into locks."<sup>2</sup> Out of the fewer than 1,000 venom toxins that have been analyzed by researchers so far, about a dozen medications have been developed and brought to market.

*"It's a challenge to find the toxin that hits only a certain target, but already top medicines for heart disease and diabetes have been derived from venom. New treatments for autoimmune diseases, cancer, and pain could be available within a decade," National Geographic continued.<sup>3</sup>*

## 10 Animal Venoms Used in Medicine

To get an idea of just how many potential uses there are for animal venom, check out this list compiled by CNN.<sup>4</sup>

1. **Brazilian lancehead viper** — Its venom was once used on the tips of arrowheads and to help treat high blood pressure. In 1981, it became the first venom-based drug approved by the US Food and Drug Administration (FDA).
2. **Saw-scaled viper** — This viper's venom was used to create the myocardial infarction drug tirofiban. Viper venom is known to prevent blood from clotting, which is useful for anticoagulant drugs.
3. **Venomous marine snails** — Venom from the cone snail was used to make the drug ziconotide, which is used to treat chronic pain.
4. **Gila monster** — Its venom was used to create the type 2 diabetes drug exenatide.
5. **Sea anemones** — Toxins from these sea creatures are being used to create medications to treat autoimmune diseases.
6. **Venomous fish** — More than 1,000 species of fish have venom (such as the lionfish). Their venom remains largely unexplored by science.
7. **Deathstalker scorpion** — Its venom is being used in trials to help locate tumors during surgery.
8. **Fire-bellied toad** — Venom from the fire-bellied toad is being used to develop drugs that help with imaging and identifying prostate cancer.
9. **King cobra** — A specific toxin in King Cobra venom shows promise for treating chronic pain.
10. **Sea snakes** — Venom from sea snakes remains largely unexplored.

## There May Be 100 Toxins in One Venom

When venoms are used to make medicine, it's the toxins that are actually used (not the venoms themselves). Any given venom many contain a mix of 20 to 100 toxins, each of which must be identified structurally and then studied to reveal the relevant receptors on human cells.<sup>5</sup>

Because the toxins have existed for millions of years and target a specific receptor, they typically have few unwanted side effects. However, the dosages must be carefully monitored, as even very small amounts may prove to be fatal. It may be seven to 25 years from the time a toxin is identified to the time a new drug is brought to market.

To date, the FDA has approved seven drugs derived from animal venom (for conditions such as high blood pressure, heart conditions, chronic pain, and diabetes). Ten more are currently in clinical trials while many others are in pre-trial stages.

One such venom comes from the king cobra, from which a toxin that has pain-relieving effects was isolated. According to CNN.<sup>6</sup>

*"The team manipulated the toxin's ability to act on the central nervous system to produce a drug capable of reducing sensitivity to pain. They say their trials in mice have shown painkilling effects 20 times greater than morphine and with zero side-effects so far."*

# Centipedes, Spiders, and Other Sources of Potentially Beneficial Venom

Snakes are the primary target for venom research, in part because they're among the easiest species to collect venom from and in part because they often target warm-blooded animals as prey, making the venoms particularly relevant to humans. However, other creatures, from leaches and lizards to snails and bees, are also being studied. For instance:

- A protein in spider venom has shown promise for slowing down the progression of muscular dystrophy<sup>7</sup>
- A peptide from centipede venom appears to have more pain-relieving power than morphine without any side effects<sup>8</sup>
- Toxins from sun anemone venom may block nerve channels and help to reverse paralysis associated with multiple sclerosis in animals<sup>9</sup>

## World Toxin Bank Attempting to Create a Worldwide 'Toxin Library'

Zoltan Takacs, founder of the World Toxin Bank project, is attempting to create a worldwide animal toxin library to help further the research and use of potentially healing animal venoms. However, many venomous species are currently at risk, even before their venom has a chance to be studied. National Geographic reported:<sup>10</sup>

*"The medical potential of venom, Zoltan Takacs never tires of saying, is 'mind-blowing.' But we're at risk of losing the sources of that potential faster than we can identify their toxin gifts.*

*Snakes, in adapting to fill varied niches all over the globe, have evolved a stunning range of venomous compounds. But snakes are in decline, as are so many other animals. The oceans too are under pressure; their changing chemistry could wipe out promising sources of venom, from cone snails to octopuses.*

*'In conserving biodiversity worldwide,' Takacs says, 'we should better appreciate molecular biodiversity.' That would put the molecules in nature's deadliest potions high on the agenda when conservation decisions are made. And that would be a lifesaver."*

While science continues to harness this awesome power of nature, do keep a lookout for venomous species in your area. According to World Health Organization (WHO) estimates, 5 million bites from venomous species lead to at least 100,000 deaths each year.<sup>11</sup>

However, the actual number is likely far higher, since venomous bites to those living in developing countries, especially in rural areas, may never be reported.

## Sources and References

<sup>1, 2, 3, 10, 11</sup> [National Geographic February 2013](#)

<sup>4, 5, 6</sup> [CNN September 15, 2015](#)

<sup>7</sup> [Science Daily July 16, 2012](#)

<sup>8</sup> [PNAS September 30, 2013](#)

<sup>9</sup> [Smithsonian Magazine March 21, 2013](#)

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