

THE CHEMISTRY OF SPIDER VENOM

Spider venoms are complex mixtures with a large number of components. This graphic looks at the chemical identities of some of these components, and their roles in venoms.

TYPES OF VENOM

Venoms are grouped into two main categories, necrotic or neurotoxic, though some spider venoms can exhibit both types of effect.



NECROTIC

Also referred to as 'cytotoxic'. Damages and kills the cells and tissue around the site of the bite, causing blisters, inflammation, and lesions to appear. Recluse spiders and South African Sand spiders have necrotic venom.

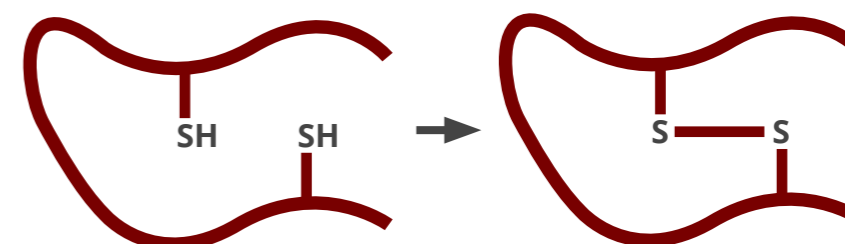


NEUROTOXIC

These venoms act directly on the nervous system. They interfere with nerve signals; in extreme cases, this can lead to death from respiratory or cardiac failure. Black Widow & Funnel Web spiders have neurotoxic venom.



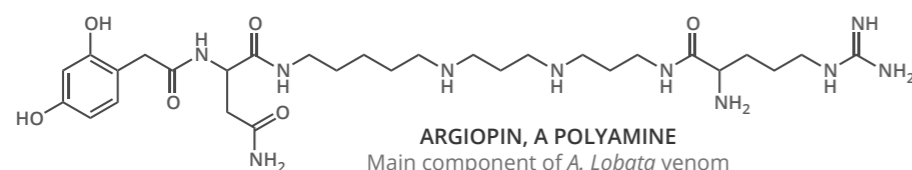
LINEAR & DISULFIDE-CONTAINING PEPTIDES



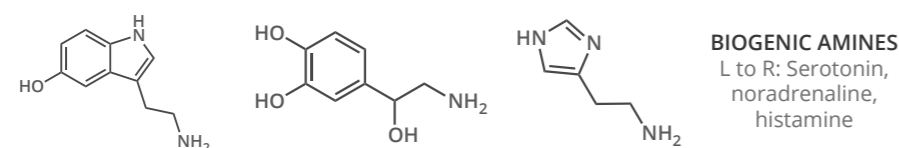
DISULFIDE BONDS IN A PEPTIDE
Disulfide bonds form between thiol (-SH) groups on peptide chains

Cytolytic peptides are linear molecules, responsible for the necrotic activities of some venoms. They show activity against a broad range of target cells, have a function in aiding external digestion, and can also be synergistic with neurotoxins. Larger peptides containing disulfide bonds are neurotoxic, exerting effects by acting on certain ion channels. They are the major toxic components of the majority of spider venoms.

LOW MOLECULAR WEIGHT COMPOUNDS



These are defined as compounds with a molecular weight of less than 1000, and include salts, carbohydrates, amino acids, amines, and acylpolyamines, some of which act synergistically with other venom components. Amines can contribute pain, and also help the venom spread from the bite site. Acylpolyamines help paralyze invertebrate victims by blocking ion channels that are activated by glutamate, but can also be effective against vertebrate nervous systems.



43,244

Number of different spider species catalogued (as of 2011)

150,000

Estimated number of different spider species in existence

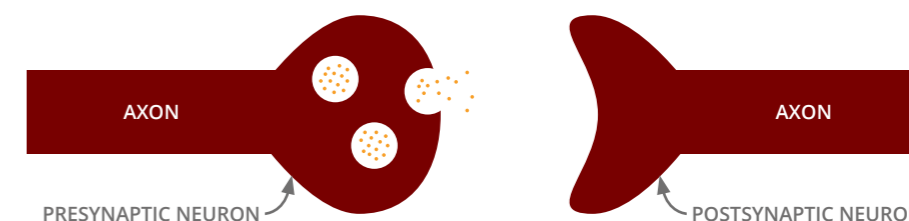
174

Number of species for which venom components described

Almost all spiders produce venom, but very few produce venom that is harmful to humans. Venoms are often investigated for potential agricultural and medicinal uses.

PROTEINS & ENZYMES

Enzymes in the venom play an important role in external digestion, and some can also act as spreading agents for the venom. In Recluse spider venoms, atracoxins are the primary toxic component. In Widow spiders, high molecular weight neurotoxins called latrotoxins cause release of neuromediators, resulting in blockade of nerve signal transmission.



NEURONS, SYNAPSES & AXONS

Many spider venom proteins bind to various molecular targets on neurons. Other venom components can assist them in reaching these. Greek letters in front of a toxin often denote its target; α = nicotine, acetylcholine and glutamate receptors, κ = potassium ion channels, μ = sodium ion channels, and ω = calcium ion channels.