THE SCIENCE WORLD
A Monthly e Magazine
ISSN:2583-2212

Popular Article

July, 2023; 3(07), 1576-1578

Spider Venom as Bio-Insecticide

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https://doi.org/10.5281/zenodo.8179463

Introduction

Insecticidal toxins derived from insect predators and parasitoids are of growing interest in the development of bio-insecticides at present. One of the major features contributing to the overall success of spiders is the production of a highly toxic venom from their venom glands that they employ to subdue prey and deter predators. Since they rely completely on predation as a trophic strategy, spiders have evolved a complex pre-optimized combinatorial library of enzymes, neurotoxins and cytolytic compounds in their venom glands. Most spider venoms are dominated by small disulfide-rich peptide neurotoxins and these are the largest and most extensively studied group of spider toxins. To date, around 922 peptide toxins from 78 spider species have been described in Arachno-Server 2.0.

Importance Of Spider Venom

Spider venom can be use as pesticides, prevention of atrial fibrillation and prevention of brain damage. It also acts as the neurotoxins, myotoxins, haemorrhagins, haemotoxins, nephrotoxins, cardiotoxins and necrotoxins (Anon., 2013).

Characteristics Of Spider Venom and Its Mode of Action

Chemical complexity of spider venoms is extra ordinary and compounds can be broadly grouped into five classes on the basis of their chemical structure. It includes salts and small organic compounds, linear cytolytic peptides, disulfide-rich peptide neurotoxins, enzymes and large pre-synaptic neurotoxins (Glenn and Margaret, 2013).

Spider venom immobilizes their prey, begins process of digestion and defences against enemies with simple as well as multiple actions: Insect Na_v channels, Ca_v channels, K_v channels, membrane-acting linear peptides, pre-synaptic nerve terminals and glutamate receptors. Spider toxins δ-CNTX-Pn1a, Γ-CNTX-Pn1a,

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*Published:*23.07.2023

κ-HXTX-Hv1c, μ-AGTX-Aa1d, μ-DGTX-Dc1a, ω-HXTX-Hv1a as they infect various important Blattarians, Dipterans, Lepidopterans and Orthopterans pest insects (Windley *et al.,* 2012).

Effect Of Spider Venom on Insect Pests

Lipkin *et al.* (2002) reported that venom of the central Asian spider, *Segestria florentina* caused the complete flaccid paralysis of *Heliothis virescens* larvae at LD_{50} 4–10 μg/g whereas, spiders' venom was injected in to the hemocele of *Apis mellifera*, *Gryllus assimilis* and *Diatraea saccharalis* caused either paralysis or death by each venom (Palma *et al.,* 2003). Lethality of brown spider, *Loxosceles intermedia* crude venom was 0.90 ± 0.11, 1.92 ± 0.71, 1.80 ± 0.30, 1.39 ± 0.34 μg/g for *S. frugiperda, S. cosmioides, A. ipsilon* and *D. saccharalis,* respectively (Castro *et al.,* 2004). Venom of Australian funnel web spider when injected subcutaneously into fifth or sixth instar larvae of *Helicoverpa armigera* was lethal or caused an apparently irreversible writhing (Vonarx *et al.,* 2006). PD_{50} values of venom from fiddle back spider, *Loxosceles arizonica* did paralysis in cricket at 0.364 μg/g dose (Pamela *et al.,* 2012). All of the theraphosid spider venoms exhibited remarkably similar LD_{50} values of 46-126 μg/g for crickets and 0.5-4 μg/g for mealworms (Glenn *et al.,* 2009). When Spider toxins were injected into the hemocele of pea aphid, *Apis pisum,* LD_{50} values ranged from 1 to 8 ng/mg body weight, with ω- hexatoxin-Hv1a being the most toxic (1.02 ng/mg body weight) (Pal *et al.,* 2013). Australian tarantula spider venom caused 98 % mortality in mealworm and 77% in termite by injection and orally, respectively. They also found that the larvae of mealworm were died within 60 min. at 50 nM OAIP (Margaret *et al.,* 2013).

Application Of Spider-Venom Toxins

- **As bait application method:** Peptide (ω-HXTX-Ar1a) isolated from venom of Australian funnel-web spider was orally active against lepidopteron pests when expressed in cotton (*Gossypium* spp.*),* poplar *(Populus* spp.*), and* tobacco *(Nicotiana tabacum)* plants (Jiang *et al.,* 1996).
- **Along with entomopathogenic fungus:** The transgenic fungus caused 50% higher mortality of the tobacco hornworm, *Manduca sexta* and the dengue vector, *Aedes aegypti* with lower conidial doses as compare to wild-type fungus (Wang and Leger, 2007).
- **In combination with Beculoviruses:** Improvement in insecticidal activity of beculoviruses resulted by incorporation of a spider venom peptide (μ-agatoxin-Aa1d, μ-Aga IV) (Maggio *et al.,* 2010).
- **Transgenic plants:** Mortality of second-instar *H. armigera* fed on transgenic tobacco expressing ω-HXTX-Hv1a was 75–100% after 72 h compared to 0% for larvae fed on control plants (Khan *et al.,* 2006). It has even been claimed that transgenic cotton expressing ω-HXTX-Hv1a is as effective as Monsanto's pyramided Bollgard II cotton in controlling major cotton pests (Omar and Ali, 2012).
- **Combination with chemical insecticide:** Margaret *et al.* (2013) observed more than 78% mortality of cotton bollworm when imidacloprid is combining with Australian tarantula venom.

Conclusion

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- Spider venom is the rich source of potential bio-insecticides that have desirable attributes of high potency, novel target activity, structural stability, phyletic selectivity, broad pest-species specificity and have low toxicity in non-target organisms.
- The hyperstable insecticidal mini-proteins of venom cause paralysis or lethality through the modulation of ion channels, receptors and enzymes in insect.
- It can be delivered to insect pests via many different routes, including incorporation of transgenes encoding the peptides into entomopathogens or crop plants.

Future Trust

- After collection and identification of spider there is need to find out insecticidal activity of spider venom.
- Need to study safety aspects.
- There is an urgent need to develop synthetic spider venom peptides.

References

Anonymous (2013). www.chm.bris.ac.uk/motm/spider/page7.htm
Copping, L. and Menn, J. (2000). *Pest Manage. Sci.*, **56**: 651-676.
Castro, C. S.; Galindo, S. F. and Araujo, S. C. (2004). *Toxicon*, **44:** 273–280.
Glenn, F. K. and Margaret, C. H. (2013). *Annu. Rev. Entomol.*, **58**: 475-496.
Glenn, F. K.; Margaret, C. G.; Jones A. and Herlinda C. (2009). *Toxicon*, **53**: 496–502.
Jiang, H.; Zhu, Y. X.; and Che, Z. L. (1996). *J. Integr. Plant Biol.*, **38**: 95–99.
Khan, S. A.; Zafar, Y.; Briddon, R.W.; Malik, K. A. and Mukhtar, Z. (2006). *Transgenic Res.*, **15**: 349–357.
Lipkin, A.; Kozlov, S.; Nosyreva, E.; Blake, A.; Windass, J. D. and Grishin, E. (2002). *Toxicon*, **40**: 125 -130.
Margaret, C. H.; Norelle, L. D.; Mehdi, M.; Rodrigo, A. V. M. and Glenn, F. K. (2013). *PLoS ONE*, **8**(9): e73136.
Maggio, F.; Sollod, B. L.; Tedford, H. W. and Glenn, F. K. (2010). *Insect Pharmacology: Channels, Receptors, Toxins and Enzymes*, pp. 101–23. London:Academic
Omar, A. and Ali, C. K. (2012). *Asian J. Manage. Case.*, **9**: 33–58.
Palma, M. F.; Gobbi, N. and Palma, M. S. (2003). *J. Venom. Anim. Toxins incl. Trop. Dis.*, **9**(2)**:** 1-6.
Pal, N.; Yamamoto, T.; Glenn, F. K.; Clement, W. and Bryony, B. (2013). *Toxicon*, **70**: 114-122.
Pamela, A. Z.; Alec, E. K. and Greta, J. B. (2012). *Toxicon*, **60**: 265-271.
Vonarx, E. J.; Tyler, M. I.; Atkinson, R. K. and Howden, M. E. H. (2006). *J. Venom. Anim. Toxins incl. Trop. Dis.*, **12**(2): 215-233.
Wang, C. and Leger, R. J. (2007). *Nat. Biotech.*, **25**: 1455–1456.
Windley, M. J.; Herzig, V.; Dziemborowicz, S. A.; Margaret, C. H.; Glenn, F. K. and Nicholson, G. M. (2012). *Toxins*, **4**: 191–227.

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***Published:*23.07.2023**