Biochemical venom modulation in spiders is achieved via compartmentalized toxin production and storage

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< It is well known that the venom produced by lethal Australian funnel-web spider *Hadronyche infensa* is a complex cocktail of peptides, proteins and small molecules affecting a wide variety of molecular targets. The venom itself is required for predatory and defensive purposes, and at the same time is quite metabolically expensive for the spider to produce. During this study we investigated how the spider might modulate the venom usage by examining the defensive secretion series. Analysis of these series revealed the venom composition changes throughout the secretion series, with the more potent insecticidal toxins secreted later in the series. To further understand what is associated with this apparent biochemical modulation of secreted venom, we used mass spectrometry imaging to reveal the spatial distribution of venom components within the venom gland. This approach showed differential storage of toxins in the venom gland, which, we propose is an important underlying factor in the apparent ability to modulate the secreted venom. The potent insecticidal toxins were stored toward the rear of the gland, which correlates well with the observed secretion series and delayed peak of toxicity, and it also correlates with the well-known defensive display of the funnel-web spider. We propose that this compartmentalisation of venom components is an adaptation that reduces the metabolic expense of venom production and perhaps also serves to minimize effects from development of toxin resistance during predator-prey co-evolution.

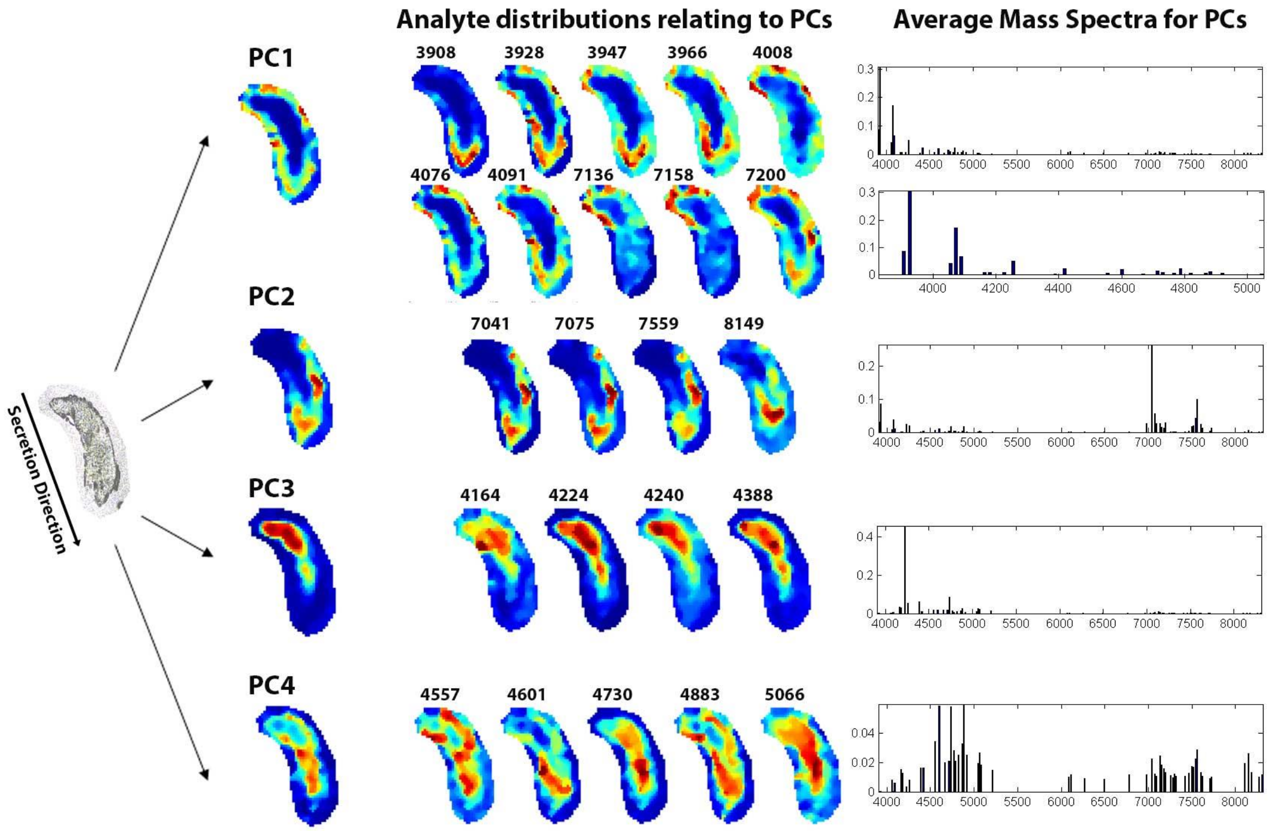

Figure1. Compartmentalisation of toxin production in funnel-web spider venom glands. Probabilistic latent semantic analysis (pLSA) performed on IMS data obtained from linear positive analysis of funnel-web spider venom-gland sections revealed four principle components, or regions, of toxin production. Inspection of the loading plots reveals the particular masses that contribute significantly to each of these components. Shown are the four major components and selected masses that relate to them.>

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