Identification and Structural Characterization of Novel Cyclotide with Activity against an Insect Pest of Sugar Cane


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Cyclotides are a family of plant-derived cyclic peptides comprising six conserved cysteine residues connected by three intermolecular disulfide bonds that form a knotted structure known as a cyclic cystine knot (CCK). This structural motif is responsible for the pronounced stability of cyclotides against chemical, thermal, or proteolytic degradation and has sparked growing interest in this family of peptides. Here, we isolated and characterized a novel cyclotide from Palicourea rigida (Rubiaceae), which was named parigidin-br1. The sequence indicated that this peptide is a member of the bracelet subfamily of cyclotides. Parigidin-br1 showed potent insecticidal activity against neonate larvae of Lepidoptera (Diatraea saccharalis), causing 60% mortality at a concentration of 1M but had no detectable antibacterial effects. A decrease in the in vitro viability of the insect cell line from Spodoptera frugiperda (SF-9) was observed in the presence of parigidin-br1, consistent with in vivo insecticidal activity. Transmission electron microscopy and fluorescence microscopy of SF-9 cells after incubation with parigidin-br1 or parigidin-br1-fluorescein isothiocyanate, respectively, revealed extensive cell lysis and swelling of cells, consistent with an insecticidal mechanism involving membrane disruption. This hypothesis was supported by in silico analyses, which suggested that parigidin-br1 is able to complex with cell lipids. Overall, the results suggest promise for the development of parigidin-br1 as a novel biopesticide.

Keywords: cyclotides, parigidin-br1, insecticidal activity.
Supported by: CNPq and CAPES