Biosynthesis, Evolution and Structural Diversity of the Cyclic Peptides Buried within Precursors for Daisy Seed Albumins

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Biography

Josh is a geneticist and biochemist who has worked broadly in plant genetic engineering (PhD Botany, UQ 2002), developmental genetics and epigenetics at the UK's John Innes Centre (2001-2005) and peptide biochemistry in the IMB, a biomedical institute at UQ (2006-2012). He has held successive, national Australia Research Council QEII and Future Fellowships (2008-2016), was Australia's 2012 Goldacre Medal winner, a 2014 Feinberg Foundation Visiting Fellow to the Weizmann in Israel and was based at the University of Minnesota for 3 months as a 2018 Fulbright Professional Scholar. He founded his lab at the School of Molecular Sciences (mylne.org) in 2013, became tenured in 2017 and an Associate Professor in 2018. In 2021 he became a Professor and the Deputy Director at Curtin University's Centre for Crop and Disease Research. His lab has focussed on studies in protein evolution, peptide biosynthesis and structural enzymology, but currently (in close collaboration with synthetic organic chemists) pursues research programs in herbicide development and target discovery as well as *in planta* fungicide metabolism.

Abstract

A 14-residue circular peptide from sunflower seeds called SFTI-1 was discovered by Russian and British scientists in 1999 [1]. It's a potent inhibitor of trypsin and possible anti-feedant that's since been embraced as a scaffold and drug lead by the peptide community. Subsequent to its discovery, the most interesting aspect about SFTI-1 is its extraordinary biosynthesis; its sequence is buried inside a latent region of an otherwise dull seed storage albumin protein [2-4]. This strange dual biosynthesis has led to some interesting findings such as the mechanism for the ring-forming reactions [5-7] and its structural basis [8-10]. The biosynthesis of this family of peptides buried inside daisy seed albumin genes has been shown to have evolved stepwise over 45 million years [11-13]. A diverse and surprising range of ultra-stable peptide topologies with different physicochemical properties have evolved within sunflower relatives including tiny 5-residue rings, SFTI-like bi-cyclic peptides, a large hoop peptide and even a strange 28-residue ladder [14-19]. We have shown how easy this kind of 'hijacking' of protein hosts can be [20] and unearthed an unrelated family of helical hairpin peptides similarly buried and processed from within a latent region of seed vicilin precursors [21,22]. I will conclude with a historical segue to explain the genetic origins for the first plant cyclopeptide ever discovered; namely evolidine discovered in Australia back in the early 1950s[23].

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