Serpins in fruit and vegetative tissues of apple (Malus domestica): expression of four serpins with distinct reactive centres and characterisation of a major inhibitory seed form, MdZ1b

Most serpins irreversibly inhibit serine proteinases of the chymotrypsin family using a suicide-substrate-based mechanism. Serpins are present in all domains of life, but physiological functions in the plant kingdom are yet to be elucidated. Inhibitory properties of many abundant cereal grain serpins are well characterised, but serpins have not been identified in eudicot seeds. In apple (Malus domestica Borkh.), the origin of 88 serpin expressed sequence tags (ESTs) identified among 160 000 ESTs from 30 cultivar-, tissue- and time-specific libraries showed that serpin genes are expressed in a wide variety of tissues, including developing and mature fruits, seeds and vegetative buds as well as developing, mature and senescing leaves. Analysis of 46 sequences, most full-length, identified serpins with four distinct reactive centres belonging to two subfamilies (MdZ1 and MdZ2) with similar to 85% amino acid sequence identity. MdZ1 included three molecular forms with identical reactive centre loop (RCL) sequences except for three different, but related, residues at P-2 (Asp, Asn or Glu). A major seed serpin, MdZ1b, with P-2-P-1' Glu-Arg-Arg was purified from decorticated seeds and characterised kinetically. MdZ1b was a fast inhibitor of bovine and porcine trypsin (second-order association rate constant k(a) similar to 4 x 10(6) M-1 s(-1) and stoichiometry of inhibition SI = 1). Human plasmin and urokinase-type plasminogen activator (u-PA), but not thrombin, were inhibited at lower rates (k(a) similar to 10(4) M-1 s(-1)). Chymotrypsin was inhibited at the same site (k(a) similar to 4 x 10(3) M-1 s(-1)), but a significant part of MdZ1b was cleaved as substrate (SI > 2). Unexpectedly, the MdZ1b-trypsin complex was relatively short-lived with a first-order dissociation rate constant k(d) in the order of 10(-4) s(-1). The bulk of mature seed MdZ1b was localised to the cotyledons. The content of MdZ1b in ripe apples was 5-26 μg per seed, whereas MdZ1b could not be detected in the cortex or skin. Localisation and inhibitory specificity of serpins in monocot and eudicot plants are compared and putative functions are discussed.

General information
State: Published
Organisations: Enzyme and Protein Chemistry, Department of Systems Biology, Department of Biochemistry and Nutrition
Contributors: Hejgaard, J., Laing, W., Marttila, S., Gleave, A., Roberts, T. H.
Pages: 517-527
Publication date: 2005
Peer-reviewed: Yes

Publication information
Journal: Functional Plant Biology
Volume: 32
Issue number: 6
ISSN (Print): 1445-4408
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 2.45 SJR 1.067 SNIP 0.937
Web of Science (2017): Impact factor 2.083
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.65 SJR 1.085 SNIP 0.988
Web of Science (2016): Impact factor 2.121
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 2.91 SJR 1.253 SNIP 1.135
Web of Science (2015): Impact factor 2.491
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 2.96 SJR 1.297 SNIP 1.268
Web of Science (2014): Impact factor 3.145
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.05 SJR 1.214 SNIP 1.262
Web of Science (2013): Impact factor 2.569
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 2.82 SJR 1.311 SNIP 1.208