From digestion to immunity: role of insect beta-1,3-glucanases

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Laminarinases are enzymes hydrolyzing beta-1,3-glucans from fungal or plant cell walls, and are widespread among insects. They are endo or exo-glucanases, and are classified based on substrate specificity (E.C. numbers) or on primary structure analysis (glycosyl hydrolase families). We have studied in detail digestive beta-1,3-glucanases from *Periplaneta americana* (Dictyoptera), *Abracris flavolineata* (Orthoptera), *Tenebrio molitor* (Colepotera), *Spodoptera frugiperda* (Lepidoptera), *Lutzomyia longipalpis* (Diptera), *Aedes aegipty* (Diptera) and from several termite species. All these enzymes seem to be secreted by the insect, and not by microorganisms from food or gut microbial communities. Insect beta-1,3-glucanases may have specific roles as digestion of cereal mixed beta-1,3-1,4-glucans (*P. americana*), digestion of callose (*A. flavolineata*) or fungal cell walls in detritivores (*T. molitor, L. longipalpis, A. aegipty*) or herbivores (*S. frugiperda*). In termites these enzymes may digest both plant or fungal beta-glucans. These enzymes show very particular kinetic properties, as high processivity (*A. flavolineata*), special subsite arrangements in the active site (*P. americana*) or particular substrate specificity (*T. molitor*). Some insect beta-1,3-glucanases work at extreme alkaline pHs (*S. frugiperda* and *L. longipalpis*). Alkaline pH optimum in these enzymes seems to be related to a high isoeletric point and to changes at the surface charges. Besides, *A. aegipty* beta-1,3-glucanase is only expressed after ingestion of fungal cells. Cloning and sequencing of these enzymes revealed that they are members of glycosyl hydrolase family 16, being probably homologous to beta-glucan binding proteins from the invertebrate humoral immune system.

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