Role of Chitinases in Various Organisms

Mainly, organisms require these chitinolytic enzymes for three different purposes.

1. Organisms possess a tough layer of chitin and chitinases are expressed during developmental phases to help in the ***remodelling of their exoskeleton*** so as to maintain and support body size and shape.
2. Organisms that ***consume*** other chitin containing organisms as a source of nutrient express chitinases ***to digest the insoluble chitin*** polymer into absorbable metabolites, which gives energy.
3. Organisms that are prone to **infection** by chitin-coated microorganisms express chitinases to **degrade the protective shield of the infecting pathogens**, thereby providing immunity.

Different forms and specific functions of chitinases in bacteria, fungi, insects, plants, and vertebrates are described below for comprehensive appraisal:

A. Bacteria

- Bacteria mainly produce chitinases in order to supply nitrogen and carbon as a source of nutrients or precursors and parasitism. They are used for degradation of chitin and its utilization as an energy source. Chitinases play an important role in bacterial pathogenesis wherever host contains chitin. *Serratia marcescens*, one of the best studied chitinolytic bacteria, has been reported producing mainly four types of chitinases ChiA, ChiB, ChiC, and CBP21 (chitin binding protein).
- All three chitinases belong to family 18 of glycosyl hydrolases with (β/α) 8 TIM-barrel catalytic domain with approximately six sugar subsites. ChiA and ChiB have multimodular organization, that is, have an N-terminal chitin binding module with a fibronectin-like fold in ChiA or a C-terminal CBM5 module. CBM modules found in chitinases are distantly related, and they are characterized by presence of conserved exposed tryptophan residues that interact with the substrate. Presence of this domain increases the substrate binding affinity as well as efficiency of chitin hydrolysis, particularly for more crystalline forms of chitin.
- Marine bacteria such as Vibrio are well studied because they solely live on chitin, which is highly abundant in marine ecosystems. Therefore they serve as an ideal candidate for bioconversion of chitin biomaterials for various purposes. The chitin degradation machinery of Vibrio is proved to be highly efficient. Structure and functions of chitinases and chitin uptake system in Vibrio are well studied. The interacting sugars undergo conformational changes prior to hydrolysis by the wild-type enzyme with the help of crystallographic data obtained by four X-ray structures of *Vibrio harveyi* chitinase A and its catalytically inactive mutant (E315M) in the presence and absence of substrates. Recently, chitoporin (VhChiP), a sugar-specific channel responsible for the transport of chito-oligosaccharides through the outer membrane of the