

**REVIEW ARTICLE**ISSN:2394-2371
CODEN (USA):IJPTIL**Interaction pattern of Systemin with SR 160 receptor for activation of wound defensive gene**Mohan Kumar Yadav^{*1}, Sumit Govil¹, Shailesh Kumar³¹School of Life Sciences, Jaipur National University, Jaipur-302025, Rajasthan, India²Amity Institute of Biotechnology, Amity University Rajasthan, Jaipur-303002, Rajasthan, India**ABSTRACT**

In many plant species have defensive mechanism to protect themselves from the predators by synthesizing defensive chemicals. Systemin is an 18-amino acid polypeptide hormone in plants, responsible for the activation of defensive genes. The release of systemin occurs at wound sites of the tomato leaves, binds with the surface receptor SR160 to carry out the downstream process for the activation of the genes. The pathway involves the binding of systemin with SR160 leading to release of linolenic acid from the membrane which is subsequently converted into jasmonic acid that have the potential to activate the defensive genes. All amino acid sequences of systemin are conserved and important for the maximal activation of the proteinase inhibitor gene expression. Their studies of binding interaction reported that the amino acids near COOH terminus responsible for the function and the amino acids near NH terminus responsible for the interaction with receptor. How systemin binds with its receptor SR160 and what are their functional native complex structure is still unclear.

Keywords: - Systemin, prosystemin, SR160, proteinase inhibitor, jasmonic acid, linolenic acid.

INTRODUCTION

Protein-protein interactions have very important roles at almost every level of cell function, about 40% of all p-p interactions are protein with flexible peptides[1] that folds upon binding with protein receptor and these

peptides lack secondary and tertiary stable structure known as intrinsically disordered protein (IDPs)[2]. It has very important role in biological pathways in cell signalling, regulation and control, it is directly or indirectly associated with the activation of genes which control the functions of a living cell in plants. The disordered segments of the peptides allow interacting with several proteins in multiple pathways and hence it is associated with many diseases. Systemin is IDPs, found in

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tomato leaves containing 18 amino acids sequences, and obtained with its prohormone precursor, prosystemin. Firstly it was isolated from the leaves of *Solanum lycopersicum* commonly known as tomato in 1991[6]. Systemin hormone reported as the signal for the activation of the systemic wound response. Systemin binds with its receptor SR160 to activate an intracellular signaling cascade leading to defensive gene activation [3] (Fig.1). The systemin receptor SR160 from *Lycopersicon peruvianum* (wild tomato) reported as a member of leucine-rich repeat receptor (LRR) kinase family and closely related to the brassinolide receptor kinase BRI1 from *Arabidopsis thaliana*, having sequence identity at kinase and domain region. Systemin signaling through SR160 activates a second regulator, JA (Jasmonic acid), which in turn activates defense genes expression hence identified as systemin receptor which activates the cascade pathway [7]. Yet there is no experimental study was available regarding how systemin binds with SR160.

Roles of Systemin and SR160 in Biological pathway

Many plant species respond to herbivore attacks by synthesizing defensive chemicals which induce the plant defensive genes and protect them from predators.

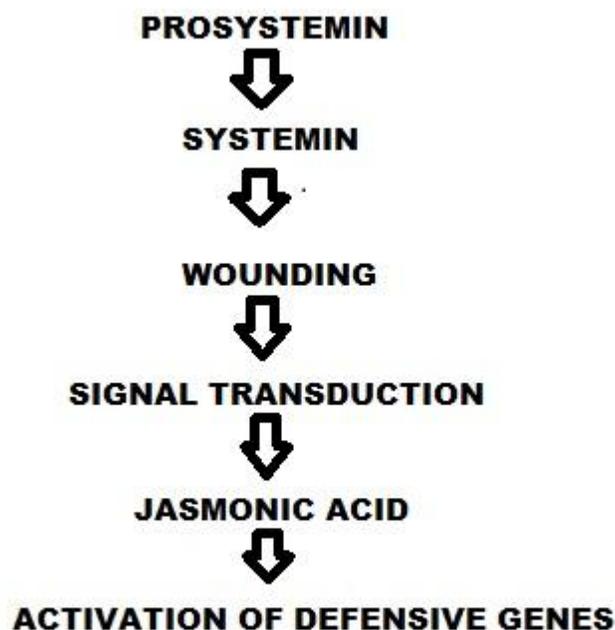


Fig.1 Showing steps of the intracellular pathway in tomato plants for the activation of defensive genes.

A 18-aminoacid polypeptide known as systemin were isolated from Tomato leaves, key roles in systemic wound signaling and a primary signal for systemic defense. It is an intracellular signaling molecule that is synthesized within the phloem from a 200 amino acid sequence precursor, called prosystemin[6] . Systemin found to induce proteinase inhibitor in young tomato plants when it supplied from outside for a few minutes through their cut stems at nano molar concentrations. It is different from animal peptide hormones and it lacks signal sequence

that is required for synthesis and process through the **secretory** pathway. Systemin activates defensive genes by interacting with a cell-surface receptor called SR160, it is the first step of a complex intracellular signaling pathway that involves the activation of a mitogen-activated protein kinase (MAPK) followed by the rapid alkalinization of the extracellular medium, the activation of a phospholipase and the release of linolenic acid that is converted into oxylipins such as phytodienoic acid and jasmonic acid that are powerful signals for the activation of defensive genes (Fig.1). The pathway exhibits analogies to the inflammatory response in animals in which wounding activates MAPKs, phospholipases, the release of arachidonic[3] . It has been reported that the entire 18- aa sequence of systemin ” AVQSKPPSKRDPPKMQTD” is important for maximal proteinase inhibitor-inducing activity, experiment was performed with mutating at different aa residues of the Systemin[4] . Pathogenic signals are perceived by membrane-localized receptor inside plant cells to activate the systemic pathway for inducing the defensive genes in tomato. The systemin peptide binds with its putative receptor SR160 and induces the wound defensive genes and protects the plant. In the Arabidopsis genome, more than 600 receptor-like kinase (RLK)

genes are known and about 200 of which belong to a family called leucine-rich repeat (LRR) receptor-like kinases (LRR-RLKs) The main characteristics of LRR-RLKs are their extracellular domains which are composed of tandem repeats of a well conserved leucine-rich motif and intracellular protein kinase domains with Ser-Thr specificity. LRRs often participate in protein–protein interactions and, therefore, are believed to function in ligand binding. The highly matched amino acid sequence of SR160 indicated that it is a member of the leucine-rich repeat (LRR) receptor kinase family and closely related to the brassinolide receptor kinase BRI1[7-9] .

CONCLUSION

Systemin signaling pathway regulates the cell specific expression of the defensive genes in tomato plant and protect against herbivores and other mechanical injury. The systemin 3D structure and the prediction of the functional binding complex of ‘Systemin-SR160’ is remains the point of research. Insilico dynamic simulation will help to understand the binding behaviour of the complex in better way. The potential peptide can be designed to control the transcription factor regulated by the interaction of systemin with its receptor SR160 hence systemin polypeptide can be use as an external

natural products to regulator the expression of the defensive genes in tomato.

REFERENCES

1. H. Li., L. Lu., R. Chen., L. Quan., X. Xia., and Q. Lu., PaFlexPepDock: Parallel Ab-Initio Docking of Peptides onto Their Receptors with Full Flexibility Based on Rosetta, PLoS ONE, 9.5, e94769 (2014).
2. I. Staneva., Y. Huang., Z. Liu., and S. Wallin., Binding of Two Intrinsically Disordered Peptides to a Multi-Specific Protein: A Combined Monte Carlo and molecular Dynamics study, PLOS Computational Biology, 8.9, e10002682 (2012).
3. Y. Yin., D. Wu., and J. Chory., Plant receptor kinases: Systemin receptor identified, PNAS, 99.14, 9090-9092 (2002).
4. J. M. Scheer., C. A. Ryan., and Jr., The systemin receptor SR160 from *Lycopersicon peruvianum* is a member of the LRR receptor kinase family, PNAS, 99.14, 9585-9590 (2002).
5. J. M. Scheer., and C. A. Ryan., A 160-kD Systemin Receptor on the surface of *Lycopersicon peruvianum* Suspension-Cultured Cells, The plant cell, 11, 1525-1535, (1999).
6. C. A. Ryan., and G. Pearce., SYSTEMIN: A Polypeptide Signal for the Plant Defensive Genes, Annu. Rev. Cell Dev. Biol., 14, 1-17, (1998).
7. C. A. Ryan., and G. Pearce., Systemins: A functionally defined family of peptide signals that regulate defensive genes in Solanaceae species, PNAS, 100, 14577-14580 (2003).
8. G. Pearce., S. Johnson., and C. A. Ryan., Structure- Activity of Deleted and Substituted Systemin, an 18- Amino Acid Polypeptide Inducer of Plant Defensive Genes, The Journal of Biological CHEMISTRY, 268.1, 212-216, (1993).
9. B. Raveh., N. London., L. Zimmerman., O. Schueler-Furman., Rosetta FlexPepDock ab-initio: Simultaneous Folding, Docking and Refinement of Peptides onto Their Receptors, PLoS ONE 6.4, e18934 (2011).