International Journal of Entomology Research
www.entomologyjournals.com
ISSN: 2455-4758
Received: 29-07-2022, Accepted: 15-08-2022, Published: 31-08-2022
Volume 7, Issue 8, 2022, Page No. 188-192

Features of insect anti-microbial poly peptides and its application

Ragaei M, M A Abdel-Raheem, Huda H El-Behery, A Abdel-Rahman
Department of Pests and Plant Protection, Agricultural and Biological Research Institute, National Research Centre, Cairo, Egypt

Abstract
Insects are the basis for the production of antimicrobial peptides, which act as a line of defense against fungi, bacteria and parasites. Antimicrobial peptides are very effective against the fungal apparatus.
The immune system is the first line of defense against pathogens. Peptides show an antimicrobial effect by disrupting the microbial membrane. The complete genome of Tribolium has been published. Antimicrobial peptides can be applied in vaccine development.

Keywords: antimicrobial peptides, structure, activity, mechanism, modification

Introduction

Insects A variety of antimicrobial peptides effective in insects were first found in bacteria-fortified pupae of giant silkworms, *Samia cynthia* and *Hyalophora cecropia* [1] and entire insect flies of the type *Drosophila melanogaster* by bacteria [2]. The first insect antimicrobial peptide was obtained from the cocoons of *H. cecropia* in 1980 [3].
Beetles make up 40% of the insect species that appear in this match, and *Tribolium golliopteran* is a better model than Drosophila [4]. Butterfly, fields, insects, insects, insects, immune [5]. Virus present in Drosophila [6]. The sequenced Tribolium genome has been obtained on ancestral genes involved in cellular communication and development maintained in Tribolium, not in Drosophila [4].
Antimicrobial Polypeptides are small peptides characterized by an overall positive charge, hydrophobicity, and amphipathicity. Structurally, two broad groups are found: the linear α-helical and cysteine-containing forms with one or more disulfide bridges and β-hairpin-like, β-sheet, or mixed α-helical/-sheet structures [7]. Their distinctive physical and chemical properties facilitate interactions with the phospholipid bilayer in the cell membranes of pathogens [8]. It has been shown that antimicrobial polypeptides directly kill pathogens by disrupting their membranes. Several models exist, the first of which is the “cylindrical stick” model in which transmembrane pores are created by amphipathic α-helical peptides, disrupting the cell membrane of pathogens. Second, the 'carpet' model suggests that the peptides dissolve the membrane [9].
A sample that is assembled by sapecin from Sarcophaga peregrina, preserved in the presence of hydrophobic and hydrophilic sites on microbial polypeptides. The general body of the peptides allows the formation of pores in the walls of the hydrophilic and hydrophobic regions and the hydrophilic chains associated with the acyl chains of the pathogen's membrane phospholipids [10]. In subtle difference to the bust model is the formation of a dynamic layer nucleus by hydrophilic regions of peptide and lipid head groups and is catalyzed by magainins, melittin and protegrins [11]. Antibacterial peptides enter the cytoplasm of Aspergillus nidulans and kill the fungi by intracellular molecules [12].
The sequencing of the Tribolium genome has led to advances in biotelling informatics analyzes based on different comparisons [13]. *Antimicrobial polypeptides* have a role as factors affecting the innate immune system are involved in the resumption of pathological processes and states [14]. Antibacterial activity is a chemical activity [15, 16]. The number of 12 antimicrobial peptides was defined in Tribolium compared to 20 in Drosophila [17]. IV defensin is found in the mixed branch of the hymen. The overall picture of coleoptricin inspired, stimulated by bacteria [18]. The larvae of *Lumirina dicotoma* beetles were immunized with *Escherichia coli*. Coleoptricin also acts against *Staphylococcus aureus*, MRSA, and *Bacillus subtilis* [19, 20]. Insect peptides adopt the fold of the knots and were identified from the clown beetle Acrocinus longimanus [19]. Psacotheasin has also been identified from the yellow longhorn beetle Psacothea hilaris [20, 21]. Psacotheasin kills Candida albicans by inducing apoptosis [21]. It has clinical significance as it causes human immunodeficiency diseases [22].
It was initially predicted by [17] and more recently by another study of the burial beetle *Nicrophorus vespiloides* [18, 23]. It appears that intima signaling occurs via the Toll and IMD pathways (Fig. 1).

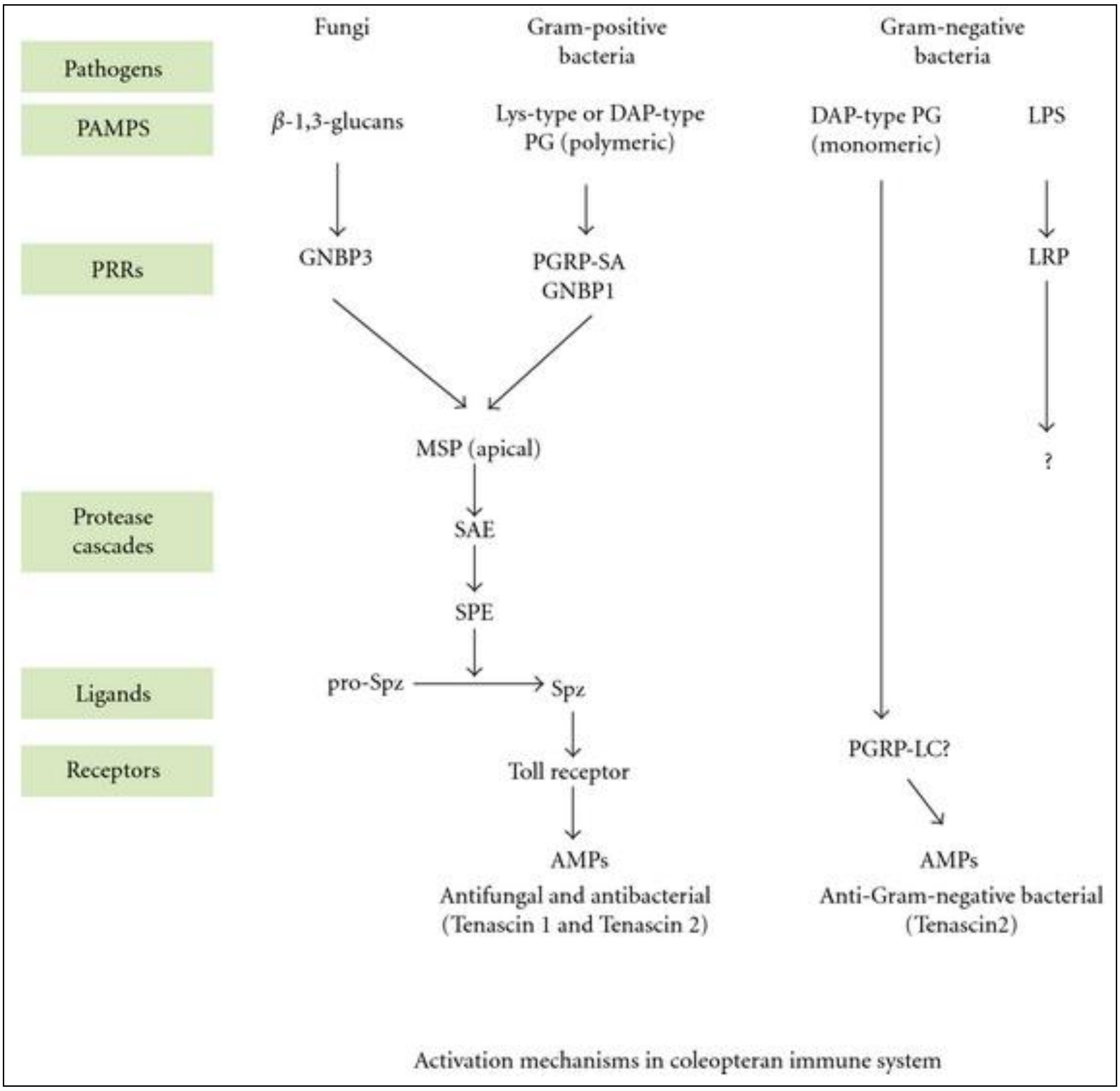

Fig 1: The immune system and its activation mechanisms, (Monde, et al., 2012) [24].

Most of the antimicrobial polypeptides for small insects have cationic/essential activities against bacteria and/or fungi, and some antimicrobial peptides are also shown to have activities against some parasites and viruses.

1. Insect defensins

It consists of 34-51 remains composed of insects, which is a phrase consisting of six individuals. High density cysteine has different names, such as sabicin [25], royalisin [26] lutein, holotricin 1 [27], holotricin-1 [28], helomycin [29], spodoptericin [30], galerimycin [31], and coprisin [30], and lucifensin [31], may belong to the insect defensin. Some insect defense compounds are also active against Gram-negative Escherichia coli and some fungi [33,34]. It may lead to the formation of channels in the cytoplasmic membrane of bacteria [34].

2. Cecropins

Cecropins are a family of antimicrobial cationic peptides isolated from the immunogenic hemolymph of *H. cecropia* pupae [36]. Secrobins and have a wide range of activity against Gram-negative and Gram-positive bacteria, fungi [37-38].

3. Attacins

Attacins were purified from the hemolymph of bacteria from *H. cecropia* pupae. *G. morsitans* attacin-A1 is effective against *Escherichia coli* and parasites [39]. H. cunea Attacin-B is effective against Gram-negative *Escherichia coli* and *C. albicans* [40].

4. Lebocins

Lebocins were isolated from hemolymph of *E. coli* silkworm, *B. mori*, proline-rich and Oglycosylated peptides 32 [41]. Lebocins are ornamental against Gram-negative and Gram-positive bacteria and some fungi. *B. mori* lebocins. In favor of Gram-negative Acinetobacter sp. and *Escherichia coli*, and O glycosylation [42].

5. Moricins
Moricin was isolated from the hemolymph of *B. mori* larvae as a highly essential peptide [43]. Moricin is found only in Lepidoptera insects. Moricin has activity against Gram-negative and Gram-positive bacteria, and type *G. mellonella* moricins also shows high activity against filamentous fungi and yeast [44-46].

6. Gloverins
Gloverin is a glycine-rich antibacterial protein, which is purified from the hemolymph of Hyalophora gloveri pupae [47]. Gloverins mainly from *Escherichia coli*, higher activity than from *Escherichia coli* [48, 49].

7. Thaumatins
Thaumatins are antifungal peptides. They are present in beetles, aphids and termites, but among the Diptera, thaumatin has been identified in two chironomids [50, 51].

Conclusions
Insect antimicrobial peptides were discovered by in situ purification of peptides from insects. Whereas antimicrobial peptides are an alternative to antibiotics nowadays. Antimicrobial peptides are good at transmissibility, selectivity, rapid killing, broad spectrum of antimicrobials, and lack of resistance development**.** Highlighting the importance of peptides more through their relationship to the outside. These wings are the most evolutionarily insectivorous**.**

References
1. Boman HG, Nilsson-Faye I, Paul K, Rasmuson T. Jr Insect immunity I. Characteristics of an inducible cell-free antibacterial reaction in hemolymph of Samia cynthia pupae. Infect Immun,1974:10:136-145.
2. Robertson M, Postlethwait JH. The humoral antibacterial response of Drosophila adults. Dev Comp Immunol,1986:10:167-179.
3. Hultmark D, Steiner H, Rasmuson T, Boman HG. Insect immunity. Purification and properties of three inducible bactericidal proteins from hemolymph of immunized pupae of Hyalophora cecropia. Eur J Biochem,1980:106:7-16.
4. Tautz D. “Insects on the rise,” Trends in Genetics,2002:18(4):179-180.
5. Hoffmann JA. “The immune response of Drosophila,” Nature, vol. 426, no. 6962, pp. 33–38, 2003. J. A. Hoffmann, “Primitive immune systems,” Immunological Reviews,2004:198:5-9.
6. Bulet P, Stöcklin R. “Insect antimicrobial peptides: structures, properties and gene regulation,” Protein and Peptide Letters, vol. 12, no. 1, pp. 3–11, 2005. P. Bulet, R. Stöcklin, and L. Menin, “Anti-microbial peptides: from invertebrates to vertebrates,” Immunological Reviews,2004:198(1):169-184.
7. Tossi A, Sandri L, Giangaspero A. “Amphipathic, α-helical antimicrobial peptides,” Peptide Science,2000:55(1):4-30.
8. Reddy KVR, Yedery RD, Aranha C. “Antimicrobial peptides: premises and promises,” International Journal of Antimicrobial Agents,2004:24(6):536-547.
9. Matsuzaki K. “Magainins as paradigm for the mode of action of pore forming polypeptides,” Biochimica et Biophysica Acta,1998:1376(3):391-400.
10. Mani R, Cady SD, Tang M, Waring AJ, Lehrer RI, Hong M, “Membrane-dependent oligomeric structure and pore formation of a β-hairpin antimicrobial peptide in lipid bilayers from solid-state NMR,” Proceedings of the National Academy of Sciences of the United States of America,2006:103(44):16242-16247.
11. Hale JDF, Hancock REW. “Alternative mechanisms of action of cationic antimicrobial peptides on bacteria,” Expert Review of Anti-Infective Therapy,2007:5(6):951-959.
12. Zou Z, Evans JD, Lu Z, *et al*. “Comparative genomic analysis of the *Tribolium* immune system,” Genome Biology,2007:8(8):R177.
13. Scott MG, Hancock REW. “Cationic antimicrobial peptides and their multifunctional role in the immune system,” Critical Reviews in Immunology,2000:20(5):407-431.
14. Meyer JE, Harder J. “Antimicrobial peptides in oral cancer,” Current Pharmaceutical Design, vol. 13, no. 30, pp. 3119–3130, 2007. A. F. Gombart, N. Borregaard, and H. P. Koeffler, “Human cathelicidin antimicrobial peptide (CAMP) gene is a direct target of the vitamin D receptor and is strongly up-regulated in myeloid cells by 1,25-dihydroxyvitamin D3,” FASEB Journal,2005:19(9):1067-1077.
15. Zhang L, Falla TJ. “Cosmeceuticals and peptides,” Clinics in Dermatology,2009:27(5):485-494.
16. Altincicek B, Knorr E, Vilcinskas A. “Beetle immunity: identification of immune-inducible genes from the model insect *Tribolium castaneum*,” Developmental and Comparative Immunology,2008:32(5):585-595.
17. Sagisaka A, Miyanoshita A, Ishibashi J, Yamakawa M. “Purification, characterization and gene expression of a glycine and proline-rich antibacterial protein family from larvae of a beetle, Allomyrina dichotoma,” Insect Molecular Biology,2001:10(4):293-302.
18. Anselme C, Pérez-Brocal V, Vallier A, *et al*. “Identification of the weevil immune genes and their expression in the bacteriome tissue,” BMC Biology,2008:6(1):43.

19. Yu Y, Park JW, Kwon HM, *et al*. "Diversity of innate immune recognition mechanism for bacterial polymeric meso-diaminopimelic acid-type peptidoglycan in insects," Journal of Biological Chemistry,2010:285(43):32937-32945.
20. Barbault F, Landon C, Guenneugues M, *et al*. "Solution structure of Alo-3: a new knottin-type antifungal peptide from the insect *Acrocinus longimanus*," Biochemistry,2003:42(49):14434-14442.
21. Nguyen MH, Peacock JE, Morris AJ, *et al*. "The changing face of candidemia: emergence of non-*Candida albicans* species and antifungal resistance," American Journal of Medicine,1996:100(6):617-623.
22. Wang G, Li X, Wang Z. "APD2: the updated antimicrobial peptide database and its application in peptide design," Nucleic Acids Research,2009:37(1):D933-D937.
23. Lata S, Mishra NK, Raghava GPS. "AntiBP2: improved version of antibacterial peptide prediction," BMC Bioinformatics,2010:11(1):S19.
24. Monde Ntwasa, Akira Goto, and Shoichiro Kurata. Coleopteran Antimicrobial Peptides: Prospects for Clinical Applications, Hindawi Publishing Corporation International Journal of Microbiology Volume 2012, Article ID 101989, 8 pages doi:10.1155/2012/101989.
25. Matsuyama K, Natori S. Purification of three antibacterial proteins from the culture medium of NIH-Sape-4, an embryonic cell line of Sarcophaga peregrina. J Biol Chem,1988:263:17112-17116.
26. Fujiwara S, Imai J, Fujiwara M, Yaeshima T, Kawashima T, Kobayashi K. A potent antibacterial protein in royal jelly. Purification and determination of the primary structure of royalisin. J Biol Chem,1990:265:11333-11337.
27. Moon HJ, Lee SY, Kurata S, Natori S, Lee BL. Purification and molecular cloning of cDNA for an inducible antibacterial protein from larvae of the coleopteran, Tenebrio molitor. J Biochem,1994:116:53-58.
28. Lee SY, Moon HJ, Kawabata S, Kurata S, Natori S, Lee BL. A sapecin homologue of Holotrichia diomphalia: purification, sequencing and determination of disulfide pairs. Biol Pharm Bull,1995:18:457-459.
29. Lamberty M, Ades S, Uttenweiler-Joseph S, Brookhart G, Bushey D, Hoffmann JA, *et al*. Insect immunity. Isolation from the lepidopteran Heliothis virescens of a novel insect defensin with potent antifungal activity. J Biol Chem,1999:274:9320-9326.
30. Volkoff AN, Rocher J, d'Alencon E, Bouton M, Landais I, Quesada-Moraga E, *et al*. Characterization and transcriptional profiles of three Spodoptera frugiperda genes encoding cysteine-rich peptides. A new class of defensin-like genes from lepidopteran insects? Gene,2003:319:43-53.
31. Schuhmann B, Seitz V, Vilcinskas A, Podsiadlowski L. Cloning and expression of gallerimycin, an antifungal peptide expressed in immune response of greater wax moth larvae, Galleria mellonella. Arch Insect Biochem Physiol,2003:53:125-133.
32. Hwang JS, Lee J, Kim YJ, Bang HS, Yun EY, Kim SR, *et al*. Isolation and Characterization of a Defensin-Like Peptide (Coprisin) from the Dung Beetle, Copris tripartitus. Int J Pept, pii, 2009, 136284.
33. Cerovsky V, Zdarek J, Fucik V, Monincova L, Voburka Z, Bem R. Lucifensin, the long-sought antimicrobial factor of medicinal maggots of the blowfly Lucilia sericata. Cell Mol Life Sci.,2010:67:455-466.
34. Lee YS, Yun EK, Jang WS, Kim I, Lee JH, Park SY, *et al*. Purification, cDNA cloning and expression of an insect defensin from the great wax moth, Galleria mellonella. Insect Mol Biol.,2004:13:65-72.
35. Lowenberger C, Bulet P, Charlet M, Hetru C, Hodgeman B, Christensen BM, *et al*. Insect immunity: isolation of three novel inducible antibacterial defensins from the vector mosquito, Aedes aegypti. Insect Biochem Mol Biol.,1995:25:867-873.
36. Cociancich S, Ghazi A, Hetru C, Hoffmann JA, Letellier L. Insect defensin, an inducible antibacterial peptide, forms voltage-dependent channels in Micrococcus luteus. J Biol Chem.,1993:268:19239-19245.
37. Steiner H, Hultmark D, Engstrom A, Bennich H, Boman HG. Sequence and specificity of two antibacterial proteins involved in insect immunity. Nature,1981:292:246-248.
38. DeLucca AJ, Bland JM, Jacks TJ, Grimm C, Cleveland TE, Walsh TJ. Fungicidal activity of cecropin A. Antimicrob Agents Chemother,1997:41:481-483. [PMC free article]
39. Ekengren S, Hultmark D. Drosophila cecropin as an antifungal agent. Insect Biochem Mol Biol,1999:29:965-972.
40. Hultmark D, Engstrom A, Andersson K, Steiner H, Bennich H, Boman HG. Insect immunity. Attacins, a family of antibacterial proteins from Hyalophora cecropia. EMBO J,1983:2:571-576.
41. Hu Y, Aksoy S. An antimicrobial peptide with trypanocidal activity characterized from Glossina morsitans morsitans. Insect Biochem Mol Biol,2005:35:105-115.
42. Kwon YM, Kim HJ, Kim YI, Kang YJ, Lee IH, Jin BR, *et al*. Comparative analysis of two attacin genes from Hyphantria cunea. Comp Biochem Physiol B Biochem Mol Biol,2008:151:213-220.
43. Hara S, Yamakawa M. A novel antibacterial peptide family isolated from the silkworm, Bombyx mori. Biochem J,1995:310(Pt 2):651-656.
44. Hara S, Yamakawa M. Moricin, a novel type of antibacterial peptide isolated from the silkworm, Bombyx mori. J Biol Chem,1995:270:29923-29927.
45. Brown SE, Howard A, Kasprzak AB, Gordon KH, East PD. The discovery and analysis of a diverged family of novel antifungal moricin-like peptides in the wax moth Galleria mellonella. Insect Biochem Mol Biol,2008:38:201-212.

46. Dai H, Rayaprolu S, Gong Y, Huang R, Prakash O, Jiang H. Solution structure, antibacterial activity, and expression profile of Manduca sexta moricin. Journal of peptide science: an official publication of the European Peptide Society,2008:14:855-863.
47. Axen A, Carlsson A, Engstrom A, Bennich H. Gloverin, an antibacterial protein from the immune hemolymph of Hyalophora pupae. Eur J Biochem,1997:247:614-619.
48. Kawaoka S, Katsuma S, Daimon T, Isono R, Omuro N, Mita K, Shimada T. Functional analysis of four Gloverin-like genes in the silkworm, Bombyx mori. Arch Insect Biochem Physiol,2008:67:87-96.
49. Lundstrom A, Liu G, Kang D, Berzins K, Steiner H. Trichoplusia ni gloverin, an inducible immune gene encoding an antibacterial insect protein. Insect Biochem Mol Biol,2002:32:795-801.
50. Mackintosh JA, Gooley AA, Karuso PH, Beattie AJ, Jardine DR, Veal DA. A gloverin-like antibacterial protein is synthesized in Helicoverpa armigera following bacterial challenge. Dev Comp Immunol,1998a:22:387-399.
51. Mrinal N, Nagaraju J. Intron loss is associated with gain of function in the evolution of the gloverin family of antibacterial genes in Bombyx mori. J Biol Chem,2008:283:23376-23387.