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ANTI-MICROBIAL PEPTIDES AND ITS FUNCTIONAL STUDIES ON AUSTRUCA ANNULIPES - A REVIEW PAPER

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Abstract

Fiddler crabs have numerous adaptations for life on land, and they also display astonishing behavioural complexity and adaptability for an invertebrate.Fiddler Fiddler crabs, belonging to the family Ocypodidae and subfamily Ucinae, are widely distributed throughout the world's tropics and subtropics. Austruca annulipes exact colour is known to be a smooth orange to red claw and a black shell with blue or white stripes. Austruca annulipes, the Body width is about 1.5-2 cm. The main cheliped of a male fiddler crab is larger than the minor cheliped, which is smaller. Antimicrobial protein spresent in Austruca annulipes Until now some proteins have been identified in this species. Fiddler crabs typically live in intertidal environments with muddy or sandy open flats of protected coastlines, river banks, salt marshes, and mangrove muck. Austruca annulipes usually pink, but occasionally almost white, the expanded pincer is.

Keywords: *Austruca annulipes; Betuline; Antimicrobial proteins; Enolase; Histone*

Introduction

Fiddler crabs, belonging to the family Ocypodidae and subfamily Ucinae, are widely distributed throughout the world's tropics and subtropics. The males' feeding behaviour, which comprised a tiny claw that travelled from the ground to its mouth in a manner like how a bow would be moved across a fiddle, gave rise to the name "Fiddler Crab" (the large claw). They are most closely related to the ghost crabs of the **"sister genus",** Ocypode. There are currently 97 recognised species and subspecies of fiddler crabs. After studying the systematic history of the genus and its members, a phylogenetic analysis of 88 species was carried out using a data matrix made up of 236 discrete morphological traits. Fiddler crabs have five pairs of legs, like other crabs do.

Due to the presence of claws, the first pair was called chelipeds. The remaining four pairs are used for walking and are referred to as legs or ambulatories. The main cheliped of a male fiddler crab is larger than the minor cheliped, which is smaller. However, both chelipeds are diminutive in female fiddler crabs.

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The proportional weight of a male Uca's big claw increases with age, going from 2% to 65% of its total body weight. The minor claw is utilised for eating, but the primary claw is only employed during battle and exhibition. At low tide, when their environment is exposed and they may feed and communicate with one another, crabs come out of their burrows. Fiddler crabs typically live in intertidal environments with muddy or sandy open flats of protected coastlines, river banks, salt marshes, and mangrove muck. Some species live close to the sea, while others can be found upstream as far as the upper intertidal limits of mangroves.

Fiddler crabs have numerous adaptations for life on land, and they also display astonishing behavioural complexity and adaptability for an invertebrate. They are also extravagant communicators who can animate the mudflat with their mass waving displays. eyes have a very specific purpose. their ability to see in a flat world, and small-scale societies are quite convenient for thorough observation and evaluation.

The decapod crustacean species *Austruca annulipes*, popularly known as the fiddler crab or calling crab, is a member of the Uca family. They are brachyuran crabs from the Ocypodidae family, the most recent aquatic organisms to reach the shore.11 of the 13 genera in the family of crabs known as Ocypodidae contain more than 100 species of fiddler crab. These species can be found in sandy or muddy shores in West Africa, the Western Atlantic, the Eastern Pacific, the Indo-Pacific, and the Algarce regions of Portugal. They can also be found in lagoons and swamps, salt marshes, mangroves, and brackish intertidal mud flats.

Features Of *Austruca annulipes*

The Body width is about 1.5-2 cm. The shape of the body is in Squarish. The male fiddler crab's enlarged pincer almost twice as long as the body width. The larger pincer's exterior palm is smooth and devoid of a triangular indentation. The flexible upper finger surpasses the rigid lower finger. Between the top and lower fingers, there is a significant space. The inside palm of the expanded pincer is bumpy in a diagonal ridge.

Usually pink, but occasionally almost white, the expanded pincer is. Body colours range from dark to light, with dark, blue, or white stripes. Walking legs short and varying in colour from dark to light, orange, brown, or reddish, with eyes dark on long yellow stalks. They consume detritus, or dead or rotting plant and animal waste, and serve as food for a variety of wetland creatures.

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Austruca annulipes

Austruca annulipes exact colour is known to be a smooth orange to red claw and a black shell with blue or white stripes.

Fiddler crabs, Austruca annulipes, both male and female crabs from the two mangrove habitats of Teluk Tempoyak and Pulau Betong, have been studied for their carapace width-weight connection and relative condition factor. 2086 individuals of A. annulipes, including 1503 males and 583 females, were obtained at mangroves in Teluk Tempoyak and Pulau Betong.

during the study period of March 2017 to February 2018. Males' average weight was 0.05 g to 2.57 g, and their average carapace width measured as part of the study ranged from 0.59 cm to 1.83 cm. Female carapace width measurements during the study ranged from 0.59 cm to 1.58 cm, and weight measurements ranged from 0.05 g to 1.44 g on average. The value of r2 shows that the width of the carapace and the weight of the male and female crabs were significantly correlated.Marine life is a great source of antibacterial proteins and is thought to be a promising therapy option for microbial illnesses.

An important chemical called chitin has a number of qualities that make it appealing for use in a wide range of medical applications as an antibacterial, antifungal, and antiviral agent. It is an essential molecule. Due to its non-toxicity and hypoallergenic nature, chitin is highly useful in experimental and pharmaceutical research.

A long, unbranched polysaccharide molecule comprised entirely of N-acetyl-D-glucosamine units, chitin is a polysaccharide that is naturally plentiful, non-toxic, and biodegradable. It is used to construct the exoskeletons of insects, as well as the shells of arthropods, nematodes, fungi, squid, jellyfish, and crabs.High antibacterial activity of chitin against

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a wide range of pathogenic and rotting microorganisms Another medical compound found in crab shells was Glucosamine, which is used in the treatment of osteoarthritis.

Some Antimicrobial activities in *Austrucaannulipes* have been studied rather than Antimicrobial proteins. Antimicrobial activities which have been identified by some methods it includes GC-MS analysis (Gas chromatography-Mass Spectrum). The result of these studies through GC-MS indicated the presence of 24 bioactive compounds in the muscle mass of *Austrucaannulipes*. In case of gas chromatogram Library the molecular weight 442 and retention index 3090 have been obtained. The compound found from those research works is named as **BETULINE.**
Betuline which as some biological activities includes, Anti cancer, Anti-inflammatory and Antimalarial activities.

Antimicrobial peptides or proteins, commonly referred to as AMPs, are essential components of the innate immune response and are present in all kingdoms, including fungi, plants, and mammals. AMPs are commonly referred to be "natural antibiotics" due to their fast and efficient antibacterial actions against a variety of pathogens, including yeast, filamentous fungus, and, to a lesser extent, protozoans and enveloped viruses (Bulet et al., 2004; Yount et al., 2006; Guan-Guerra et al., 2010). Recent research indicates that AMPs are versatile molecules that, in addition to their antibacterial activity, may carry out a variety of other unique biological tasks. A sizable quantity of information about AMPs has been compiled in AMP databases, and research on AMPs is still in its early stages.

Crustaceans are a large and diverse invertebrate animal group that mounts a complex and efficient innate immune response against a variety of microorganisms.The generation and release of significant immune effectors into the hemolymph, as well as cellular reactions, are the main components of the crustacean immune system.Crustacean AMPs are often cationic, gene-encoded compounds produced predominantly by circulating immune-competent cells (hemocytes) or derived from unrelated proteins principally involved in other biological processes.

Based on the structure and composition of the antimicrobial peptide families found in crab species, we tentatively divided them into the following four primary groups:
(1) Single-domain linear -helical AMPs and peptides rich in particular amino acids;
(2) Single-domain peptides with cysteine residues linked by disulfide bonds;
(3) Multi-domain or chimeric AMPs; and
(4) Unusual AMPs, such as multifunctional proteins and protein-derived fragments with antimicrobial properties.

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Table – 1 Single-domain linear α-helical AMPs and peptides enriched in certain amino acids

AMPs	Molecular mass (kDa)	Charge	Crustacean Order	First Descriptions
Bac-like	6.5	cationic	Decapoda (crab)	Schnappet *al.*, 1996
Callinectin	3.7	cationic	Decapoda (crab)	Khooet *al.*, 1999
Astacidin 2	1.8	cationic	Decapoda (crayfish)	Jiravanichpaisale t *al.*, 2007a
Armadillidin	5.2	cationic	Isopoda (woodlouse)	Herbinièreet *al.*, 2005
Homarin	4-6	cationic	Decapoda (lobster)	Battisonet *al.*, 2008

Table – 2 Single-domain peptides containing cysteine residues engaged in disulfide bonds

AMPs	Molecular mass (kDa)	Charge	Crustacean Order	First Descriptions
Defensin	6.7-7.1	cationic	Decapoda (lobster)	Pisuttharachaiet *al.*, 2009b
Anti-LPS factor	7-11	cationic	Decapoda (various)	Gross *et al.*, 2001 Supungulet *al.*, 2002
Scygonadin	10.8-11.4	anionic	Decapoda (crab)	Huang *et al.*, 2006

Table – 3 Multi-domain or chimeric AMPs

AMPs	Molecular mass (kDa)	Charge	Crustacean Order	First descriptions
Penaeidin	5.5-6.6	cationic	Decapoda (penaeid shrimp)	Destoumieuxe t *al.*, 1997
Crustin	7-14	cationic	Decapoda Amphipoda	Relfet *al.*, 1999
Hyastatin	11.7	cationic	Decapoda (crab)	Sperstadet *al.*, 2009b
Arasin	4.3-4.8	cationic	Decapoda	Stensvåget *al.*,

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			(crab)	2008
Stylicin	8.9	anionic	Decapoda (penaeid shrimp)	Rolland *et al.*, 2010

Table – 4 Unconventional AMPs

AMPs	Molecular mass (kDa)	Charge	Crustacean Order	First descriptions
Histones and derived fragments	11-15	cationic	Decapoda (penaeid shrimp)	Patat et al., 2004
Hemocyanin-derived peptides	2.7-8.3 (shrimp) 1.9 (crayfish)	anionic (shrimp) cationic (crayfish)	Decapoda (shrimp, crayfish)	Destoumieux-Garzón et al., 2001 Lee et al., 2003

There are now 15 AMP families or single peptides that have been identified in crustaceans that have molecular characteristics with the known AMP families.Crustacean AMPs are primarily described structurally as tiny, cationic, amphipathic molecules encoded by a single gene, as is frequently the case in other animals. AMPs that are less prevalent, such as anionic peptides, multifunctional proteins that are largely involved in other cellular processes, and protein-derived fragments that have antimicrobial properties have all been included in this definition's recent expansion. It's interesting to note that several gene-encoded AMPs in crustaceans have various structural domains.

Each of these domains has distinctive characteristics that are also present in other AMP groups, such as an excess of a certain amino acid or the presence of cysteine residues that can create disulfide bonds. These chimeric peptides may also operate as multifunctional proteins in various physiological systems, according to a recent theory.

Antimicrobial Proteins Present In *Austruca annulipes*

Until now some proteins have been identified in this species. It includes Enolase and Histone. Also through mitochondrion, cytochrome oxidase have been found.

Enolase

Enolase, a key glycolytic enzyme, belongs to a novel class of surface proteins which do not possess classical machinery for surface transport, yet through an unknown mechanism are transported on the cell surface. Enolase is a multifunctional protein, and its ability to serve as a plasminogen receptor on the surface of a variety of hematopoetic, epithelial and endothelial cells suggests that it may play an important role in the intravascular and pericellular fibrinolytic system. Its role in systemic and invasive autoimmune disorders was recognized only very recently. In addition to this property,

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its ability to function as a heat-shock protein and to bind cytoskeletal and chromatin structures indicate that enolase may play a crucial role in transcription and a variety of pathophysiological processes.
Number of amino acids: 116
Molecular weight: 12619.16
Theoretical pI: 4.87

Histone

Histones are key protein components of chromatin that are directly involved in DNA packing and gene expression control. They are cationic proteins that are highly conserved in all eukaryotic cells and may be involved in antimicrobial defence (Cho et al., 2009). Antimicrobial activity has been documented for many kinds of histones (H1, H2A, H2B, H3, and H4) in numerous vertebrate and invertebrate taxa, supporting their multifunctional features (Kashima, 1991; Park et al., 1996, 1998; Richards et al., 2001).

Their antibacterial ability may be related to their high amount of cationic residues and amphipathic secondary structure. Histones and histone-derived fragments with antibacterial action have been discovered in skin secretions and mucus of fish and amphibians (Park *et al.*, 1998; Robinette *et al.*, 1998; Fernandes *et al.*, 2002, 2004).Histones' antibacterial function appears to be connected to their ability to destabilise bacterial membranes rather than their ability to generate stable holes (Fernandes et al., 2002). However, the processes by which histones are attracted to places outside the cell nucleus, as well as the control of histone synthesis in response to microbial infections, remain unknown.
Number of amino acids: 124
Molecular weight: 14007.37
Theoretical pI: 10.86

Conclusion

In conclusion, as seen above, the in vitro and in vivo features of AMPs reveal that they are truly key components of the *Austruca annulipes* immune system. Unfortunately, the vast majority of knowledge now available only pertains to the order Decapodaand is far from all representative of the entire and extremely diverse group of crustaceans.In addition, because *Austruca annulipes* are so diverse, it is thought that there are yet undiscovered AMP families with unique chemical structures and fascinating biological characteristics just waiting to be discovered. Contrarily, it would be interesting to fill in knowledge gaps regarding the already known *Austruca annulipes* AMPs, such as their precise mode of action, in vivo activity, co-localization with other AMP members, and particularly their synergistic effect with other AMP families and/or other immunologic effectors also present in *Austruca annulipes* immune cells. This information would very certainly contribute significantly to a more thorough and integrated understanding of the crucial role that these compounds play in the immunity of *Austruca annulipes.*

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