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Review

Neuropeptides in the regulation of *Rhodnius prolixus* physiology

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ABSTRACT

In the kissing bug *Rhodnius prolixus*, events such as diuresis, antidiuresis, development and reproduction are triggered by blood feeding. Hence, these events can be accurately timed, facilitating physiological experiments. This, combined with its relatively big size, makes *R. prolixus* an excellent model in insect neuroendocrinological studies. The importance of *R. prolixus* as a Chagas' disease vector as much as an insect model has motivated the sequencing of its genome in recent years, facilitating genetic and molecular studies. Most crucial physiological processes are regulated by the neuroendocrine system, composed of neuropeptides and their receptors. The identification and characterization of neuropeptides and their receptors could be the first step to find targets for new insecticides. The sequences of 41 neuropeptide precursor genes and the receptors for most of them were identified in the *R. prolixus* genome. Functional information about many of these molecules was obtained, whereas many neuroendocrine systems are still unstudied in this model species. This review addresses the knowledge available to date regarding the structure, distribution, expression and physiological effects of neuropeptides in *R. prolixus*, and points to future directions in this research field.

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1. Introduction

Neuropeptides are signaling molecules present in multicellular organisms throughout all the levels of organization, including invertebrates and vertebrates. These molecules are produced in endocrine cells and neurons as large precursors, and are fundamental in the coordination of all the physiological processes. The precursors are cleaved and further modified to yield mature biologically active peptides that are secreted to the extracellular environment to act, through the interaction with specific receptors, as neuromodulators and/or hormones. In insects, neuropeptides and neurohormones play a central role in the control of fundamental events such as development, reproduction, behavior and feeding.

Pioneer studies on insect physiology were carried out by Sir Vincent Wigglesworth since the 1930s. During his scientific life, Wigglesworth made key discoveries about the growing, molting and reproduction in insects using the kissing bug *Rhodnius prolixus* as an experimental model (Wigglesworth, 1934, 1939, 1953, 1954, 1959, 1964). Several characteristics from *R. prolixus* make this species an interesting model for physiological studies. Even though the hematophagy could represent some difficulty for their breeding, *R. prolixus* colonies grow and reproduce under controlled conditions with a life cycle of approximately 3 months from egg eclosion to the adult stage. *R. prolixus* larvae remain in a state of arrested development until the ingestion of a large blood meal. Feeding stimulates several physiological events that lead to molt and ecdysis a predictable number of days later. This characteristic allows an accurate timing for performing experiments to study post-embryonic development (Edwards, 1998). Studies on excretion and osmoregulation are also convenient in *R. prolixus*, given that blood feeding rapidly elicits a large postprandial diuresis. Between blood meals, the bugs must conserve water and therefore do not urinate (Quinlan et al., 1997). Furthermore, given their relatively large size, dissections and surgical manipulations can be performed. The recent publication of *R. prolixus* genomic sequence (Mesquita et al., 2015) greatly facilitates genetic and molecular experiments. Importantly, like other triatomine species, *R. prolixus* is a vector of the protozoan parasite *Trypanosoma cruzi,* the causative agent of Chagas' disease. Chagas is a neglected life-threatening disease that affects about 7 million people around the world (World Health Organization, 2014). Hence, besides its importance as model species in insect physiology, the study of triatomine biology has medical relevance.

The central nervous system (CNS) in triatomines is composed of the brain, the suboesophageal ganglion (SOG), the prothoracic ganglion (PRO) and the mesothoracic ganglionic mass (MTGM) (Insausti, 1994) (Fig. 1). Abdominal nerves (ABN) and corpora cardiaca (CC) are neurohemal sites where neuropeptides are released

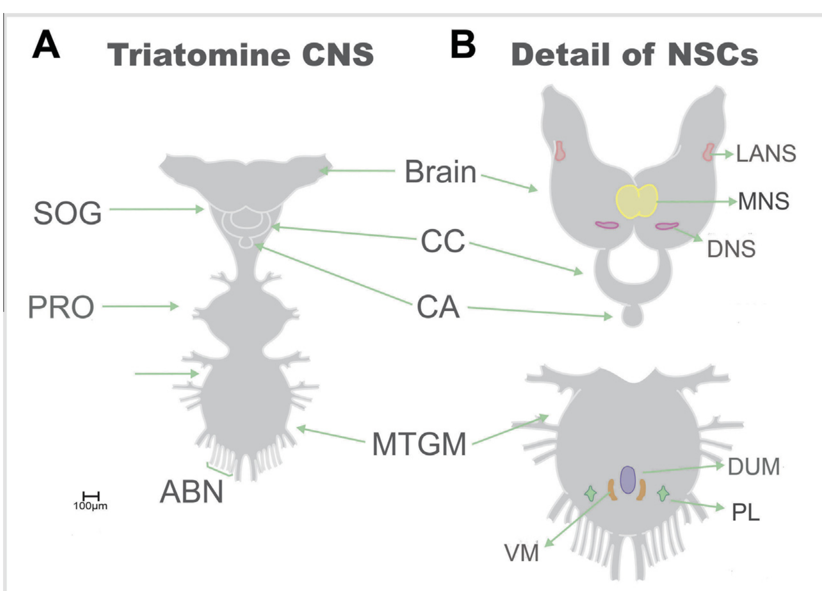

Fig. 1. (A) Schematic representation of triatomine central nervous system (CNS), ABN: abdominal nerves; CA: corpora allata; CC: corpora cardiaca; PRO: prothoracic ganglion; SOG: suboesophageal ganglion. (B) Detailed diagram of areas where neurosecretory cells (NSCs) are located. DNS: dorsal neurosecretory cells; DUM: dorsal unpaired medial neurons; LANS: lateral anterior neurons; MNS: medial neurosecretory cells; PL: posterior lateral neurosecretory cells; VM: ventromedial neurosecretory cells.

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