

6. Summary

The aim of this work was to investigate and describe the functional role of octopaminergic dorsal unpaired median (DUM) neurons during locomotion of the locust *locusta migratoria*. A new technique was developed to make chronic recordings from nerves of the ventral nerve cord without disturbing the freely moving animal. In a cooperation with the research group of Dr. Duch this technique was used to investigate the activity patterns of identified motoneurons during the late larval life of the hawkworm of *manduca sexta*.

6.1. To investigate the activity patterns of efferent DUM neurons during locomotion under in vivo conditions electrodes were implanted chronically into locusts. Due to the very small amplitude of the action potentials caused by the small diameter of the axons, it was not possible to separate the signals of DUM neurons from background activity in extracellular recordings. Using different experimental designs and analytic methods it was not possible to extract DUM cell activity from the recordings. The high signal quality of the chronically implantable electrodes makes this new technique a useful tool for further investigations.

6.2. The activity of DUM neurons during a central generated rhythm was investigated. The rhythm was induced by cutting the anterior and posterior connectives of the mesothoracic ganglion. In this preparation no pharmacological substances were applied and local sensory feedback in the segment stayed intact. It was shown that the different subtypes of DUM neurons were activated differently during central rhythmic activity. Leg innervating DUM neurons showed rhythmic depolarizations. This activity correlated strongly with the activity of motoneurons of the levator tibiae. All other subtypes of DUM neurons did not show any changes in activity or received inhibitory inputs, which were also correlated with the activity of the motoneurons of the levator.

6.3. This work shows that the DUM neuron activity has a strong influence on flight muscle metabolism in the locust. Due to antidromic stimulation of DUM neurons, the level of the potent glycolytic activator fructose 2,6-bisphosphate (f2,6bp) was increased in the flight muscle M119. The level of f2,6bp was not increased in the contralateral muscle M119 which was used as an internal control. It was also shown that the cAMP-dependent protein kinase A is necessary, but not sufficient for signal transduction of this octopamin mediated effect.

6.4. In cooperation with the workgroup of Dr. Carsten Duch activity patterns of motoneurons persisting during late larval life of *manduca sexta* were investigated. These activity patterns are specific for the developmental stages of the larvae. They correlate with stereotypic changes in behavior that occur prior to pupal ecdysis. The types of motoneurons recruited, the number of motor spikes, and the duration of bursts changed stereotypically with different stages. Inducing activity by stimulating these motoneurons selectively with ecdysis-like patterns resulted in a significant outgrowth of their terminal arborizations. In contrast, tonic stimulation with the same number of spikes did not result in a new outgrowth. This suggests that postembryonic modifications of the neuromuscular systems are affected by activity-dependent mechanisms and that they are not regulated by hormones only.