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Immunolocalization of choline acetyl-transferase in the nervous system of octopus arm

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The arms of octopus show remarkable complexity of movements and thus represent a particularly interesting example of the dynamic musculoskeletal system provided by muscular hydrostatic support. The arms perform both motor and sensory functions related to the sucker, chromatophores and the muscles of the arms; they serve a wide range of functions. We studied arm cholinergic system of *Octopus vulgaris*. The most reliable method for visualizing the cholinergic system is immunohistochemical localization of its synthesizing enzyme choline acetyl-transferase (ChAT). Two molecular forms of the enzyme, the common type (cChAT) and the peripheral type (pChAT) have been recently distinguished and two polyclonal antisera specifically recognizing and distinguishing each of them have been produced and characterized. We found both cChAT and pChAT-immunoreactivity in the axial nerve cord and immunoreactive (IR) nerve fibers localized in the intrinsic muscles of the arm and in the nerves of the sucker, but with a different distribution pattern. A major part of the axial nerve cord is composed by longitudinal tracts, the cerebro-brachial tracts, running between the brain and the axial ganglia. In this tracts we found cChAT, but no pChAT –IR fibers and many of these seem to be transverse, joining the cerebro-brachial tract to the ganglia. In the cell layer of axial nerve cord cChAT but no pChAT –IR pChAT –IR neurons were found, whereas both cChAT and pChAT –IR fibers were found in the neuropil. The intrinsic muscle of the arm showed high density of pChAT –IR neuromuscular junctions that recall the neuromuscular junctions of vertebrate muscles. This work, in a range of a more extensive study on octopus cholinergic system, provide information on the distribution pattern of ChAT immunoreactivity in arm nervous system. This study could contribute for understanding the complexity of octopus arm neuromuscular control that recently has attracted a new attention from neurophysiologists and robotics engineers who are using them as a source of inspiration for the design and construction of a new class of robotic arms.

Key words
Octopus arm, nervous system, cholinergic system, immunohistochemistry