



GÖTEBORGS UNIVERSITET

Static and Dynamic Measurement of Neurotransmitters in *Drosophila* Brain

Carina Berglund

Institutionen för kemi och molekylärbiologi
Naturvetenskapliga fakulteten

Akademisk avhandling för filosofie doktorsexamen i Kemi, som med tillstånd från Naturvetenskapliga fakulteten kommer att offentligt försvaras Torsdagen den 6 december 2012 kl. 14:00 i föreläsningssal KB, Institutionen för kemi och molekylärbiologi, Kemigården 4, Göteborg.

The thesis will be defended in English on Thursday, the 6th of December 2012, at 14:00 in lecture hall KB at Kemigården 4, Göteborg

Faculty opponent is Professor Robert Kennedy, Department of Chemistry,
University of Michigan USA

ISBN: 978-91-628-8569-4



GÖTEBORGS UNIVERSITET

ABSTRACT

Static and Dynamic Measurement of Neurotransmitters in *Drosophila* Brain

Neurotransmitters, the substances neurons use for communication, and their precursors and metabolites are of obvious importance for the wellbeing of the individual and when the neurotransmitter balance is off it can lead to catastrophic suffering as in the addiction to drugs or in neurodegenerative diseases. By understanding how neurons communicate with the environment, treatment may be found to aid in the symptoms of unbalance. *Drosophila melanogaster*, the fruit fly, has been shown to be an excellent model for understanding neuronal processes and behaviors. Although the adult fly has a simpler nervous system than those of vertebrates, it is capable of higher-order brain functions, including aversive and appetitive learning, and recalling learned information from prior experiences. Invertebrate models, such as *Drosophila melanogaster* have been used previously to investigate neurochemical changes in the CNS associated with drug addiction as well as in the study of neurodegenerative diseases such as Alzheimer's disease, Huntington's disease, and Parkinson's disease by *Drosophila* mutants. Many of the neurotransmitters associated with these diseases occur in minute amounts and can be difficult to detect in the small volume of the fly brain. As such, it is essential to develop analytical tools for these unique biological systems that can be quickly performed and accurately analyses the neuronal substances as well as requiring extremely small sample volume. Capillary electrophoresis and *in vivo* voltammetry are two methods that meet these requirements.

In Paper I a new separation scheme for capillary electrophoresis was devised to allow resolution of 23 neurotransmitters, metabolites, and precursors. In fly homogenates a focus on six of the substances thought to be involved in the response to alcohol were identified. In Paper II the removal of the cuticles and eyes leaving only the brains further enhanced the separation profile of neurotransmitters from Paper I. In Paper III a method for sample preparation by freeze drying the *Drosophila* brains was presented. The use of freeze-dried samples offers a way to preserve the biological sample while making dissection of the tiny brain samples easier and faster. This provides more concentrated samples and with that higher signals and better detection limits. In Paper IV the effect of cocaine on the dopamine transporter was shown to be reduced by the ADHD drug methylphenidate using *in vivo* voltammetry.