



Morphological and functional characterization of layer 5 neurons in rat medial prefrontal cortex, their synaptic microcircuitry and serotonin modulation

Ramya Rama

Schlüsseltechnologien / Key Technologies

Band / Volume 267

ISBN 978-3-95806-688-5

Forschungszentrum Jülich GmbH
Institut für Neurowissenschaften und Medizin (INM)
JARA-Institut Brain structure-function relationships (INM-10)

Morphological and functional characterization of layer 5 neurons in rat medial prefrontal cortex, their synaptic microcircuitry and serotonin modulation

Ramya Rama

Schriften des Forschungszentrums Jülich
Reihe Schlüsseltechnologien / Key Technologies

Band / Volume 267

ISSN 1866-1807

ISBN 978-3-95806-688-5

Table of contents

Eidesstattliche Erklärung	3
Summary	4
Zusammenfassung.....	6
Acknowledgements.....	8
1. Introduction	11
1.1. Cerebral cortex	11
1.2. Prefrontal cortex.....	11
1.3. Neuronal classification in the neocortex	13
1.4. Serotonin and its receptors.....	18
1.5. 5-HT receptor function in the context of neuropsychiatric disorders	21
1.6. Aim of this doctoral thesis	24
2. Materials and Methods	25
2.1. Slice Preparation	25
2.2. Solutions	25
2.3. Identification of cortical layers and neurons in mPFC	26
2.4. Patch-clamp technique	27
2.4.1. Single-cell recordings	27
2.4.2. Paired recordings	29
2.5. Drug Application.....	31
2.6. Analysis of electrophysiological data	32
2.6.1. Passive membrane properties of a single neuron.....	32
2.6.2. Active membrane properties of a single neuron	32
2.6.3. Physiological properties of synaptically coupled neuronal pairs.....	35
2.7. Morphological reconstructions and analysis.....	36
2.7.1. Histological procedures	36
2.7.2. Morphological 3D reconstructions	37
2.8. Statistical analysis.....	37
3. Results	39
3.1. Neuronal classification in L5 of mPFC	39
3.2. Effect of 5-HT on PN activity in L5 of mPFC.....	52
3.3. Effect of 5-HT receptor agonists on the AS and RS PNs in L5 of mPFC.....	59
3.4. Effect of 5-HT on INs in L5 of mPFC	59

3.5. Synaptic transmission in the L5 of mPFC	59
3.5.1. Synaptic connectivity between E-E pairs in L5 of mPFC	61
3.5.2. Synaptic connectivity between E-I pairs in L5 of mPFC	62
3.5.3. Synaptic connectivity between I-E pairs in L5 of mPFC	63
3.5.4. Serotonergic suppression of E-E connections in L5 of mPFC.....	64
3.5.5. 5-HT suppresses synaptic transmission of E-E microcircuitry in L5 of mPFC through 5-HT1BRs.....	64
3.5.6. Serotonergic suppression in reciprocal E-I and I-E connections in L5 of mPFC	70
3.5.7. 5-HT suppresses synaptic transmission of E-I microcircuitry in L5 of PFC through 5-HT1BRs.....	70
3.5.8. 5-HT facilitates synaptic transmission of the I-E microcircuitry in L5 of PFC through 5-HT3ARs.....	73
4. Discussion	76
4.1. Classification of PNs in L5 of mPFC	76
4.2 Classification of INs in L5 of mPFC	78
4.3. Serotonergic effect in L5 neurons in mPFC.....	81
4.3.1. Serotonergic effect in L5 PNs in mPFC.....	81
4.3.2. Serotonergic effect on SK channels in L5 PNs in mPFC.....	84
4.3.3. Serotonergic effect in L5 INs in mPFC.....	85
4.4. Monosynaptic connections in L5 of mPFC	87
4.5. Serotonergic modulation on synaptic neurotransmission in mPFC of rats.....	91
5. Bibliography	95
Abbreviations.....	111
List of Figures	113
List of Tables	115
Curriculum Vitae.....	116

Schlüsseltechnologien / Key Technologies
Band / Volume 267
ISBN 978-3-95806-688-5