

## Changes in Membrane and Threshold Potentials of Command Neurons in Terrestrial Snail during Development of a Conditioned Situational Defensive Reflex

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Changes of the electrical characteristics of command neurons of defensive behavior caused by the development of a conditioned situational defensive reflex were studied experimentally under *in vitro* conditions on preparations of the nervous system of snails. After learning, the membrane and threshold potentials of command neurons LPa3 and RPa3 significantly decreased and excitability of the studied neurons increased.

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## References

1. Balaban PM. Cellular mechanisms of behavioural plasticity in simple nervous systems. *Russ. Fiziol. Zh.* 2007;93(5):521-530. Russian.
2. Balaban PM. Molecular mechanisms of memory modification. *Zh. Vyssh. Nervn. Deyat.* 2017;67(2):131-140. Russian.
3. Gainutdinov KhL, Andrianov VV, Gainutdinova TKh. Changes of the neuronal membrane excitability as cellular mechanisms of learning and memory. *Uspekhi Fiziol. Nauk.* 2011;42(1):33-52. Russian.
4. Gainutdinov KL, Beregovoi NA. Long-term sensitization in the common snail: Electrophysiological correlates in defensive behavior command neurons. *Zh. Vyssh. Nervn. Deyat.* 1994;44(2):307-315. Russian.
5. Gainutdinov KhL, Gainutdinova TKh, Chekmarev LYu. Change in the electrical characteristics of the command neurons during defensive conditioning in a snail. *Zh. Vyssh. Nervn. Deyat.* 1996;46(3):614-616. Russian.
6. Gainutdinova TKh, Tagirova RR, Ismailova AI, Muranova LN, Gainutdinov KhL, Balaban PM. Protein synthesis-dependent reactivation of associative contextual memory in terrestrial snails. *Zh. Vyssh. Nervn. Deyat.* 2004;54(6):795-800. Russian.
7. Nikitin VP, Solntseva SV, Kozyrev SA. Anterograde Amnesia Induced by Disruption of Consolidation or Reconsolidation of Long-Term Memory. *Bull. Exp. Biol. Med.* 2017;164(1):1-5. <https://doi.org/10.1007/s10517-017-3912-x>
8. Epstein OI, Stark MB, Timoshenko AKh, Gainutdinova TKh, Gainutdinov KhL. Protective effect of low-doses of antibodies to S-100 protein on the formation of long-term sensitization in *helix lucorum* Bull. Exp. Biol. Med. 2007;143(5):559-562.
9. Andrianov VV, Epstein OI, Gainutdinova TKh, Shtark MB, Timoshenko AKh, Gainutdinov KL. Antibodies to calciumbinding S100 protein block the conditioning of long-term sensitization in the terrestrial snail. *Pharmacol. Biochem. Behav.* 2009;94(1):37-42.

10. Balaban PM, Vinarskaya AK, Zuzina AB, Ierusalimsky VN, Malyshev AY. Impairment of the serotonergic neurons underlying reinforcement elicits extinction of the repeatedly reactivated context memory. *Sci. Rep.* 2016;6. ID 36933.  
<https://doi.org/10.1038/srep36933>
11. Bogodvid TKh, Andrianov VV, Deryabina IB, Muranova LN, Silantyeva DI, Vinarskaya AKh, Balaban PM, Gainutdinov KhL. Responses of premotor interneurons to serotonin application in naïve and learned snails are different. *Front. Cell. Neurosci.* 2017;11. ID 403. <https://doi.org/10.3389/fncel.2017.00403>
12. Deryabina IB, Muranova LN, Andrianov VV, Gainutdinov KhL. Impairing of serotonin synthesis by p-clorphenylalanine prevents the forgetting of contextual memory after reminder and the protein synthesis inhibition. *Front. Pharmacol.* 2018;9. ID 607.  
<https://doi.org/10.3389/fphar.2018.00607>
13. Mozzachiodi R, Lorenzetti FD, Baxter DA, Byrne JH. Changes in neuronal excitability serve as a mechanism of long-term memory for operant conditioning. *Nat. Neurosci.* 2008;11(10):1146-1148.
14. Saar D, Barkai E. Long-lasting maintenance of learning-induced enhanced neuronal excitability: mechanisms and functional significance. *Mol. Neurobiol.* 2009;39(3):171-177.
15. Schulz DJ. Plasticity and stability in neuronal output via changes in intrinsic excitability: it's what's inside that counts. *J. Exp. Biol.* 2006;209(Pt 24):4821-4827.

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