Davor Virag, MD

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Education

PhD **University of Zagreb School of Medicine**, Biomedicine and Health — Zagreb, Croatia, 2021 – present
- *Changes of the circadian locomotor activity rhythm in a rat model of sporadic Alzheimer's disease.* Supervisor: Prof. Melita Šalković-Petrišić, MD, PhD
- Submitted Jul 2026, under committee review

MD **University of Zagreb School of Medicine**, Medicine — Zagreb, Croatia, 2013 – 2021

Research experience

Laboratory for Molecular Neuropharmacology, Department of Pharmacology, University of Zagreb School of Medicine, Research and Teaching Assistant / PhD student — Zagreb, Croatia, 2021 – present

Laboratory for Molecular Neuropharmacology, Department of Pharmacology, University of Zagreb School of Medicine, Student researcher — Zagreb, Croatia, 2018 – 2021
- Moved from clinical training into research during medical school, building and publishing devices for neurobehavioural research before graduating

Research infrastructure

Custom open-source systems for behavioural measurements or testing:

MIROSLAV. Continuous activity monitoring across 64+ home cages over months, with redundant sensing and an R toolkit for circadian model fitting. *Used in teaching:* PIROSLAV, a prototype version, was built by participants of a COST-TEATIME training school. (*Behavior Research Methods*, 2025)

VLADISLAV. Wi-Fi-controlled home cage operant testing device at roughly EUR 40 per cage, allowing self-paced daily cognitive testing without handling. (*bioRxiv* preprint, 2026)

PASTA. Platform for Acoustic STArtle, built from a digital kitchen scale load cell, for assessing startle response from pressure force measurements. Later adapted by the laboratory for rodent grip strength measurement and mucus tribometry. *Used in teaching:* built by participants of annual NeuroData Summer Schools. (*Scientific Reports*, 2021)

BeDSy. Sub-millisecond hardware synchronisation of video, ultrasonic vocalisation and sensor streams for a custom home cage apparatus, built with Dr Paul Mieske at the Bundesinstitut für Risikobewertung (BfR), Berlin, Germany. (github.com/davorvr/bedsy)

Peer-reviewed publications

My friend MIROSLAV: A hackable open-source hardware and software platform for high-throughput monitoring of rodent activity in the home cage — 2025
Virag D, Homolak J, Kodvanj I, Virag AM, Babić Perhoč A, Meglić P, Šoštarić Mužić P, Knezović A, Osmanović Barilar J, Cifrek M, Trkulja V, Šalković-Petrišić M
Behavior Research Methods 57(7):198. 10.3758/s13428-025-02719-x

Repurposing a digital kitchen scale for neuroscience research: a complete hardware and software cookbook for PASTA — 2021
Virag D, Homolak J, Kodvanj I, Babić Perhoč A, Knezović A, Osmanović Barilar J, Šalković-Petrišić M
Scientific Reports 11(1):2963. 10.1038/s41598-021-82710-6

Time- and Region-Specific Effects of Intranasal Insulin on Oxidative Stress Parameters in the Rat Brain — 2026
Osmanović Barilar J, Vlahov L, Krsnik A, Mihalić L, Babić Perhoč A, **Virag D**, Homolak J, Šalković-Petrišić M, Knezović A
FASEB Journal 40(13):e72119. 10.1096/fj.202601712R

Fluorescent but flawed: Fluorescent labelling alters brain distribution of intranasally administered insulin — 2026
Osmanović Barilar J, Krsnik A, Babić Perhoč A, **Virag D**, Homolak J, Šalković-Petrišić M, Knezović A
Diabetes, Obesity and Metabolism 28(3):2431-2436. 10.1111/dom.70357

Modeling of Parkinson's disease by intrastriatal administration of streptozotocin 2025
Osmanović Barilar J, Papić V, Farkaš V, Rubić I, Meglić P, Bagarić R, Babić Perhoč A, **Virag D**, Homolak J, Šalković-Petrišić M, Knezović A
Neuropharmacology 265:110246. 10.1016/j.neuropharm.2024.110246

Species-specific sensitivity to intracerebroventricular streptozotocin in rats and mice highlights pathways and proteins relevant to Alzheimer's disease 2025
Homolak J, Marković P, **Virag D**, Knezović A, Osmanović Barilar J, Lončar A, Šalković-Petrišić M, Babić Perhoč A
Journal of Neural Transmission 132(10):1547-1566. 10.1007/s00702-025-02952-w

Insights into insulin signalling and oxidative stress in the Tg2576 mouse model of familial Alzheimer's disease: effects of chronic oral galactose administration 2025
Babić Perhoč A, Kovač D, Homolak J, **Virag D**, Knezović A, Šalković-Petrišić M, Osmanović Barilar J
Journal of Neural Transmission 132(10):1609-1625. 10.1007/s00702-025-02969-1

Self-medication practices and the content of home pharmacies in the households of pharmacy and medical students in Zagreb, Croatia, in 2022 with a reference to the findings from 2001 and 1977 2025
Aljinović-Vučić V, Vargantolić AM, **Virag D**, Vučić M, Lacković Z, Trkulja V
Croatian Medical Journal 66(4):247-255. 10.3325/cmj.2025.66.247

Experimental Parkinsonism induced by tetanus toxin injected into basal ganglia 2025
Meglić P, Šoštarić P, **Virag D**, Knezović A, Habek N, Rossetto O, Matak I
British Journal of Pharmacology 182(18):4400-4418. 10.1111/bph.70079

Pharmacokinetics and pharmacodynamics of intranasal insulin in a rat brain 2025
Osmanović Barilar J, Vlahov L, Babić Perhoč A, Homolak J, **Virag D**, Barone E, Šalković-Petrišić M, Knezović A
British Journal of Pharmacology 182(17):4020-4040. 10.1111/bph.70057

The Absence of Gastrointestinal Redox Dyshomeostasis in the Brain-First Rat Model of Parkinson's Disease Induced by Bilateral Intrastriatal 6-Hydroxydopamine 2024
Homolak J, Joja M, Grabarić G, Schiatti E, **Virag D**, Babić Perhoč A, Knezović A, Osmanović Barilar J, Šalković-Petrišić M
Molecular Neurobiology 61(8):5481-5493. 10.1007/s12035-023-03906-7

D-galactose might mediate some of the skeletal muscle hypertrophy-promoting effects of milk—A nutrient to consider for sarcopenia? 2024
Homolak J, Babić Perhoč A, **Virag D**, Knezović A, Osmanović Barilar J, Šalković-Petrišić M
BioEssays 46(2):2300061. 10.1002/bies.202300061

Insights into Gastrointestinal Redox Dysregulation in a Rat Model of Alzheimer's Disease and the Assessment of the Protective Potential of D-Galactose 2024
Homolak J, Varvaras K, Sciacca V, Babić Perhoč A, **Virag D**, Knezović A, Osmanović Barilar J, Šalković-Petrišić M
ACS Omega 9(10):11288-11304. 10.1021/acsomega.3c07152

D-galactose might protect against ionizing radiation by stimulating oxidative metabolism and modulating redox homeostasis 2023
Homolak J, Babić Perhoč A, **Virag D**, Knezović A, Osmanović Barilar J, Šalković-Petrišić M
Journal of Radiation Research 64(4):743-745. 10.1093/jrr/rrad046

From attention-deficit hyperactivity disorder to sporadic Alzheimer's disease—Wnt/mTOR pathways hypothesis 2023
Grünblatt E, Homolak J, Babić Perhoč A, **Virag D**, Knezović A, Osmanović Barilar J, Riederer P, Walitza S, Tackenberg C, Šalković-Petrišić M
Frontiers in Neuroscience 17:1104985. 10.3389/fnins.2023.1104985

Association of Cognitive Deficit with Glutamate and Insulin Signaling in a Rat Model of Parkinson's Disease 2023
Knezović A, Piknjac M, Osmanović Barilar J, Babić Perhoč A, **Virag D**, Homolak J, Šalković-Petrišić M
Biomedicines 11(3):683. 10.3390/biomedicines11030683

The Effect of the Sodium—Glucose Cotransporter Inhibitor on Cognition and Metabolic Parameters in a Rat Model of Sporadic Alzheimer's Disease 2023
Osmanović Barilar J, Babić Perhoč A, Knezović A, Homolak J, **Virag D**, Šalković-Petrišić M
Biomedicines 11(4):1025. 10.3390/biomedicines11041025

Exploratory Study of Gastrointestinal Redox Biomarkers in the Presymptomatic and Symptomatic Tg2576 Mouse Model of Familial Alzheimer's Disease: Phenotypic Correlates and Effects of Chronic Oral d-Galactose 2023
Homolak J, Babić Perhoč A, Knezović A, Osmanović Barilar J, **Virag D**, Šalković-Petrišić M
ACS Chemical Neuroscience 14(22):4013-4025. 10.1021/acschemneuro.3c00495

Altered Secretion, Constitution, and Functional Properties of the Gastrointestinal Mucus in a Rat Model of Sporadic Alzheimer's Disease 2023
Homolak J, De Busscher J, Zambrano-Lucio M, Joja M, **Virag D**, Babić Perhoč A, Knezović A, Osmanović Barilar J, Šalković-Petrišić M
ACS Chemical Neuroscience 14(15):2667-2682. 10.1021/acschemneuro.3c00223

Publishing of COVID-19 preprints in peer-reviewed journals, preprinting trends, public discussion and quality issues 2022
Kodvanj I, Homolak J, **Virag D**, Trkulja V
Scientometrics 127(3):1339-1352. 10.1007/s11192-021-04249-7

Nitrocellulose redox permanganometry: A simple method for reductive capacity assessment 2022
Homolak J, Kodvanj I, Babić Perhoč A, **Virag D**, Knezović A, Osmanović Barilar J, Riederer P, Šalković-Petrišić M
MethodsX 9:101611. 10.1016/j.mex.2021.101611

A hacked kitchen scale-based system for quantification of grip strength in rodents 2022
Homolak J, **Virag D**, Kodvanj I, Matak I, Babić Perhoč A, Knezović A, Osmanović Barilar J, Trkulja V, Šalković-Petrišić M
Computers in Biology and Medicine 144:105391. 10.1016/j.compbiomed.2022.105391

The effect of acute oral galactose administration on the Redox system of the rat small intestine 2022
Homolak J, Babić Perhoč A, Knezović A, Osmanović Barilar J, **Virag D**, Joja M, Šalković-Petrišić M
Antioxidants 11(1):37. 10.3390/antiox11010037

Is Galactose a Hormetic Sugar? An Exploratory Study of the Rat Hippocampal Redox Regulatory Network 2021
Homolak J, Babić Perhoč A, Knezović A, Kodvanj I, **Virag D**, Osmanović Barilar J, Riederer P, Šalković-Petrišić M
Molecular Nutrition and Food Research 65(21):2100400. 10.1002/mnfr.202100400

Preliminary analysis of COVID-19 academic information patterns: a call for open science in the times of closed borders 2020
Homolak J, Kodvanj I, **Virag D**
Scientometrics 124(3):2687-2701. 10.1007/s11192-020-03587-2

Book chapters

Technologies for Home Cage Monitoring in Preclinical Research 2026
Huzard D, Adams CK, Alvarez J, Florea M, Gaburro S, Lorimer T, Mieske P, Ruiter M, Sturman O, Weber N, **Virag D**
Home Cage Monitoring in Rodents: A Global Effort (Gaburro S, Mandillo S, eds.), Springer Nature Switzerland, 171-210. 10.1007/978-3-032-19781-8_7

Achieving Independence and Precision—A Guide for Do-It-Yourself (DIY) Home Cage Monitoring 2026
Duarte-Domingues D, Mieske P, Kahnau P, Lewejohann L, Rivalan M, **Virag D**
Home Cage Monitoring in Rodents: A Global Effort (Gaburro S, Mandillo S, eds.), Springer Nature Switzerland, 235-266. 10.1007/978-3-032-19781-8_9

Preprints and manuscripts in preparation

Effects of methylphenidate, an ADHD drug, in a rat model of sporadic Alzheimer's disease 2026
Virag D, …, Šalković-Petrišić M
Manuscript in preparation

Ethical Considerations of Mitigating Data Loss: VLADISLAV, a Manifesto for Reliable Home Cage Systems 2026
Virag D, Virag AM, Homolak J, Kahnau P, Babić Perhoč A, Krsnik A, Mihalić L, Knezović A, Osmanović Barilar J, Cifrek M, Trkulja V, Šalković-Petrišić M
bioRxiv. 10.64898/2026.01.20.700603 · *Submission in preparation*

Too big to lose: a FAIR repository for biomedical data derived from home-cage monitoring 2025
Bains RS, Huzard D, McCutcheon JE, Boguszewski PM, **Virag D**, Restivo L, Lewejohann L, Ashby MC, Rozman J, Forrest H, Rivalan M, Gates H, Kalliokoski O, Girard B
OSF Preprints. 10.31219/osf.io/fsg83 · *Submission in preparation*

Non-alcoholic components of Pelinkovac, a Croatian wormwood-based strong liquor, counteract the inhibitory effect of high ethanol concentration on catalase in vitro 2022
Homolak J, Babić Perhoč A, Joja M, Kodvanj I, Toljan K, **Virag D**
bioRxiv. 10.1101/2022.01.07.475357

World Health Organization (WHO) COVID-19 Database: Who Needs It? 2020
Kodvanj I, Homolak J, **Virag D**, Trkulja V
Preprints.org. 10.20944/preprints202007.0051.v2

Separating science from science fiction: can a non-existent enzyme be a primary driver of pathophysiological processes in galactose-induced rodent models of aging? 2020
Homolak J, Kodvanj I, Toljan K, Babić Perhoč A, **Virag D**, Osmanović Barilar J, Mlinarić Z, Smailović U, Trkulja V, Hackenberger B, Lacković Z, Šalković-Petrišić M
ResearchGate (preprint). 10.13140/RG.2.2.31233.89449/1

Teaching, training and mobility

NeuroData Summer School, Workshop organiser and instructor — Zagreb, Croatia, 2024–present
- Behavioural neuroscience and instrumentation workshop within the compulsory two-week summer school of NeuroData, the Erasmus Mundus Joint Master Degree Programme in Brain and Data Science (neurodata-master.org), run jointly by the School of Medicine and the Faculty of Electrical Engineering and Computing, University of Zagreb, Croatia

2nd COST-TEATIME Advanced Training School, Workshop organiser and instructor — Berlin, Germany, 2024
- "Design and Build a Home Cage System", co-designed and led with Dr Pia Kahnau (Federal Institute for Risk Assessment, Berlin, Germany). Participants without electronics experience built working activity monitors

Federal Institute for Risk Assessment (BfR) / Freie Universität Berlin, Short-Term Scientific Mission — Berlin, Germany, 2023
- One-month stay in the laboratory of Prof. Lars Lewejohann, funded by COST-TEATIME, working on the development of novel home cage systems for welfare and refinement. Ongoing collaboration with Dr Pia Kahnau and Dr Paul Mieske, from which the BeDSy synchronisation platform originated

Bar-Ilan University, Erasmus+ staff mobility for training (STT) — Ramat Gan, Israel, 2023
- One-week visit to the laboratory of Prof. Galit Shohat-Ophir, working on motivation in *Drosophila*, to see which behavioural patterns hold across distant species and are therefore likely to translate

Projects, networks and service

HRZZ IP-2022-10-1895 2023–2027
"Diet-dependent effect of intranasal insulin on cognition in a rat model of sporadic Alzheimer disease". Doctoral researcher. PI: Dr Ana Knezović, funded by the Croatian Science Foundation.

TransADamis 2023–2024
"The role of transthyretin in sporadic Alzheimer's disease-associated leptomeningeal and cerebrovascular amyloidosis and neuroprotective potential of a brain directed tafamidis prodrug". Doctoral researcher. PI: Dr Ana Babić Perhoč, funded by Pfizer Inc., 2022 Global TTR Amyloidosis Research ASPIRE.

HRZZ IP-2018-01-8938 2021–2023
"Mechanisms of nutrient-mediated effects of endogenous glucagon-like peptide-1 on cognitive and metabolic alterations in experimental models of neurodegenerative disorders". Doctoral researcher. PI: Prof. Melita Šalković-Petrišić. Grant and PhD position funded by HRZZ DOK-2021-02.

TheBehaviourForum.org 2023–present
Open forum for laboratory animal behaviour methodology, over 1400 members. Founding team member and moderator, with J.E. McCutcheon, M. Rivalan, H. Gates and C. Lamy. Funded by COST-TEATIME and the Mary Lyon Research Centre, Harwell, UK.

COST Action CA20135 (TEATIME) 2022–2025
"Improving biomedical research by automated behaviour monitoring in the animal home-cage". Member of Working Group 3. Funded by European Cooperation in Science and Technology (COST).

Neurići workshops 2018–2020
Miniature electronic neuron simulators used to teach circuit-level neuroscience and destigmatise neuropsychiatric illness; 15+ events in schools, faculties and science festivals in Zagreb and Koprivnica, Croatia. Co-founder, self-funded.

Awards

- **Best Poster Award, Basic Pharmacology.** 11th Croatian Congress of Pharmacology with International Participation, Split, Croatia, 2025
- **Speakers Award for Best Lecture.** 20th International Medical Doctoral Conference, Charles University, Hradec Králové, Czechia, 2023
- **Best Poster Award.** 8th Croatian Neuroscience Congress, Croatian Society for Neuroscience, Croatia (online), 2021
- **Rector's Award for scientific work.** University of Zagreb, Croatia, 2020
- **Silver Award, Innovation Day.** EIT Health, 2019
- **Maker of Merit** (Neurići workshops)**.** Maker Faire Zagreb / FABLAB, Zagreb, Croatia, 2019

Skills

Behaviour: Comprehensive phenotyping using conventional (open field, Morris water maze, object recognition, etc.) and home cage paradigms; building and validating custom behavioural apparatuses; markerless pose estimation (DeepLabCut, SLEAP)

Histology and biochemistry: Brain cryosectioning and immunohistochemistry, confocal microscopy, ELISA

Computation: RNA-seq differential expression and gene set enrichment analysis (DESeq2, limma, fgsea); HPC (PBS Pro); statistics in R (mixed models, circular and longitudinal data); Python; git; GNU/Linux

Hardware and embedded: PCB design (KiCad); embedded Arduino (C++): ESP32, FreeRTOS, networking (Wi-Fi, MQTT)

Languages: Croatian (native); English (fluent); Italian (basic)