Tobias Kadi Karakach, Ph.D.

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🌐 http://www.karakachlab.org/
in https://www.linkedin.com/in/tobias-karakach-90827817/
⚙ https://github.com/itikadi

Education

2003 – 2007	🔖 Doctor of Philosophy, Department of Chemistry, Dalhousie University, Halifax, NS, Canada; with a concentration on Bioinformatics for Functional Genomics. Thesis title: Analysis of Gene Expression Microarray Data by Multivariate Curve Resolution. Thesis Supervisor: Prof. Peter D. Wentzell Full thesis at: https://dalspace.library.dal.ca/handle/10222/54836
2000 – 2002	🔖 Master of Science, Department of Chemistry, Dalhousie University, Halifax, NS, Canada; with a concentration in Chemometrics. Thesis title: Comparison of Linear and Non-Linear Multivariate Calibration Methods. Thesis Supervisor: Prof. Peter D. Wentzell

Employment History

2021 – ⋯	🔖 Assistant Professor: Faculty of Medicine, Department of Pharmacology, Dalhousie University, Halifax, NS, CANADA
2019 – 2021	🔖 Bioinfomatics Facility Manager: Children's Hospital Research Institute of Manitoba (CHRIM), Winnipeg, MB, CANADA
2017 – 2019	🔖 Staff Scientist: Vlaams Instituut vor Biotechnologie (VIB), Center for Cancer Biology, KU Leuven, VIB-KU Leuven, Department of Oncology, Leuven, BELGIUM.
2009 – 2017	🔖 Research Officer: National Research Council of Canada, Measurement Science and Standards Portfolio, Ottawa, ON, CANADA.
2007 – 2009	🔖 Research Associate: National Research Council of Canada, Institute for Marine Biosciences, Halifax, NS, CANADA.
2006 – 2007	🔖 NSERC Visiting Fellow: National Research Council of Canada, Institute for Marine Biosciences, Halifax, NS, CANADA.

Consultancy Work

2019 – ⋯	🔖 Bioinformatics Consultant: Flamingo Therapeutics Inc., Gaston Geenslaan 1, 3001 Leuven, BELGIUM.

Software

2020 – ⋯	🔖 Error Modelled Gene Expression Analysis (EMOGEA): ⚙ https://github.com/itikadi/EMOGEA
2019 – ⋯	🔖 Biological Interpretation Of Multi-omics EXperiments (BIOMEX): 🌐 https://www.vibcancer.be/software-tools/BIOMEX

Research Statement

The basis of my research is to develop and deploy novel bioinformatics approaches that allow access to important biological information embedded in the massive amounts of data generated by bio-analytical technology platforms that continue to advance. These methods push the limit in detecting small but significant bio-molecular parameters that influence important biological phenotypes. On the one hand, my approach to data analysis is integrative leading to accurate and comprehensive understanding of the correspondence between empirical observations, bioinformatics models, and principal biological truths. On the other hand, my lab employs standard molecular biology tools to validate our in silico results in order provide incontrovertible translational evidence for our predictions.

Record of Funding

Role	Funding Agency	Amount	Duration
PI	BHCRI (New Investigator Award)	$100,000	2022 - 2024
PI	Research NS (New Health Investigator Award)	$100,000	2022 - 2024
PI	Dalhousie Faculty Start-up Funds	$250,000	2021 - 2024
PI	Dalhousie Faculty of Medicine Mentorship Grant	$20,000	2021 - 2022
PI	BoB Catalyst Fund (Winnipeg, MB)	$20,000	2020 - 2021
co-Applicant	Kom op Tegen Kanker (Leuven, Belgium)	€ 200,000	2018 - 2022

Recent Awards

2021   Winner Gairnder Foundation Early Career Award Competition, Toronto, Ontario, Canada

Research Publications

Journal Articles

1 Karakach, T. K., Taverna, F. & Barra, J. (2021). Error Modelled Gene Expression Analysis (EMOGEA) for RNA-seq Measurements. Nature Methods, In Review.

2 Mahood, T. H., Pascoe, C. D., Karakach, T. K., Jha, A., Basu, S., Ezzati, P., Spicer, V., Mookherjee, N. & Halayko, A. J. (2021). Integrating Proteomes for Lung Tissues and Lavage Reveals Pathways That Link Responses in Allergen-Challenged Mice. ACS Omega. `https://doi.org/10.1021/acsomega.0c04269`
doi: 10.1021/acsomega.0c04269

3 Teuwen, L.-A., De Rooij, L. P. M. H., Cuypers, A., Rohlenova, K., Dumas, S. J., García-Caballero, M., Meta, E., Amersfoort, J., Taverna, F. & Becker, L. M. (2021). Tumor vessel co-option probed by single-cell analysis. Cell Reports, 35(11), 109253.

4 Dumas, S. J., Meta, E., Borri, M., Goveia, J., Rohlenova, K., Conchinha, N. V., Falkenberg, K., Teuwen, L.-A., de Rooij, L., Kalucka, J., Chen, R., Khan, S., Taverna, F., Lu, W., Parys, M., De Legher, C., Vinckier, S., Karakach, T. K., Schoonjans, L., ... Carmeliet, P. (2020). Single-Cell RNA Sequencing Reveals Renal Endothelium Heterogeneity and Metabolic Adaptation to Water Deprivation. Journal of the American Society of Nephrology, 31(1), 118 LP –138. `https://doi.org/10.1681/ASN.2019080832`

5 Goveia, J., Rohlenova, K., Taverna, F., Treps, L., Conradi, L.-C., Pircher, A., Geldhof, V., de Rooij, L. P. M. H., Kalucka, J., Sokol, L., García-Caballero, M., Zheng, Y., Qian, J., Teuwen, L.-A., Khan, S., Boeckx, B., Wauters, E., Decaluwé, H., De Leyn, P., ... Carmeliet, P. (2020). An Integrated Gene Expression Landscape Profiling Approach to Identify Lung Tumor Endothelial Cell Heterogeneity and Angiogenic Candidates. Cancer Cell, 37(1), 21–36.e13. `https://doi.org/https://doi.org/10.1016/j.ccell.2019.12.001`

6 Kalucka, J., de Rooij, L. P. M. H., Goveia, J., Rohlenova, K., Dumas, S. J., Meta, E., Conchinha, N. V., Taverna, F., Teuwen, L.-A., Veys, K., García-Caballero, M., Khan, S., Geldhof, V., Sokol, L., Chen, R., Treps, L., Borri, M., de Zeeuw, P., Dubois, C., ... Carmeliet, P. (2020). Single-Cell Transcriptome Atlas of Murine Endothelial Cells. Cell. `https://doi.org/https://doi.org/10.1016/j.cell.2020.01.015`

7 Dumas, S. J., Meta, E., Borri, M., Goveia, J., Rohlenova, K., Conchinha, N. V., Falkenberg, K., Teuwen, L.-A., de Rooij, L., Kalucka, J., Chen, R., Khan, S., Taverna, F., Lu, W., Parys, M., De Legher, C., Vinckier, S., Karakach, T. K., Schoonjans, L., ... Carmeliet, P. (2019). Single-Cell RNA Sequencing Reveals Renal Endothelium Heterogeneity and Metabolic Adaptation to Water Deprivation. Journal of the American Society of Nephrology, ASN.2019080832. `https://doi.org/10.1681/ASN.2019080832`

8 Karakach, T., Dachon, A., Choi, J., Miguez, C., Masson, L. & Tartakovsky, B. (2019). Fluorescence-based real time monitoring and diagnostics of recombinant Pichia pastoris cultivations in a bioreactor. Biotechnology Progress, 35(2). `https://doi.org/10.1002/btpr.2761`

9 Khan, S., Taverna, F., Rohlenova, K., Treps, L., Geldhof, V., De Rooij, L., Sokol, L., Pircher, A., Conradi, L.-C., Kalucka, J., Schoonjans, L., Eelen, G., Dewerchin, M., Karakach, T., Li, X., Goveia, J. & Carmeliet, P. (2019). EndoDB: A database of endothelial cell transcriptomics data. Nucleic Acids Research, 47(D1). `https://doi.org/10.1093/nar/gky997`

10 Tiemeier, G. L., Wang, G., Dumas, S. J., Sol, W. M. P. J., Avramut, M. C., Karakach, T., Orlova, V. V., van den Berg, C. W., Mummery, C. L., Carmeliet, P., van den Berg, B. M. & Rabelink, T. J. (2019). Closing the Mitochondrial Permeability Transition Pore in hiPSC-Derived Endothelial Cells Induces Glycocalyx Formation and Functional Maturation. Stem Cell Reports, 13(5), 803–816. `https://doi.org/https://doi.org/10.1016/j.stemcr.2019.10.005`

11 Karakach, T., McGinn, P., Choi, J., MacQuarrie, S. & Tartakovsky, B. (2015). Real-time monitoring, diagnosis, and time-course analysis of microalgae Scenedesmus AMDD cultivation using dual excitation wavelength fluorometry. Journal of Applied Phycology, 27(5). https://doi.org/10.1007/s10811-014-0494-0

12 Liu, J., Kandasamy, S., Zhang, J., Kirby, C., Karakach, T., Hafting, J., Critchley, A., Evans, F. & Prithiviraj, B. (2015). Prebiotic effects of diet supplemented with the cultivated red seaweed Chondrus crispus or with fructo-oligo-saccharide on host immunity, colonic microbiota and gut microbial metabolites. BMC Complementary and Alternative Medicine, 15(1). https://doi.org/10.1186/s12906-015-0802-5

13 Markus, M., Ferrier, J., Luchsinger, S., Yuk, J., Cuerrier, A., Balick, M., Hicks, J., Killday, K., Kirby, C., Berrue, F., Kerr, R., Knagge, K., Gödecke, T., Ramirez, B., Lankin, D., Pauli, G., Burton, I., Karakach, T., Arnason, J. & Colson, K. (2014). Distinguishing vaccinium species by chemical fingerprinting based on NMR spectra, validated with spectra collected in different laboratories. Planta Medica, 80(8-9). https://doi.org/10.1055/s-0034-1368569

14 Qiu, F., McAlpine, J., Lankin, D., Burton, I., Karakach, T., Chen, S.-N. & Pauli, G. (2014). 2D NMR barcoding and differential analysis of complex mixtures for chemical identification: The Actaea triterpenes. Analytical Chemistry, 86(8). https://doi.org/10.1021/ac500188j

15 Mitchell, P., Karakach, T., Currie, D. & McLeod, R. (2012). t-10, c-12 CLA Dietary Supplementation Inhibits Atherosclerotic Lesion Development Despite Adverse Cardiovascular and Hepatic Metabolic Marker Profiles. PLoS ONE, 7(12). https://doi.org/10.1371/journal.pone.0052634

16 Qiu, F., Imai, A., McAlpine, J., Lankin, D., Burton, I., Karakach, T., Farnsworth, N., Chen, S.-N. & Pauli, G. (2012). Dereplication, residual complexity, and rational naming: The case of the actaea triterpenes. Journal of Natural Products, 75(3). https://doi.org/10.1021/np200878s

17 MacLellan, D., Mataija, D., Doucette, A., Huang, W., Langlois, C., Trottier, G., Burton, I., Walter, J. A. & Karakach, T. (2011). Alterations in urinary metabolites due to unilateral ureteral obstruction in a rodent model. Molecular BioSystems, 7(7), 2181–2188. https://doi.org/10.1039/c1mb05080j

18 Soanes, K. H., Achenbach, J. C., Burton, I. W., Hui, J. P. M., Penny, S. L. & Karakach, T. K. (2011). Molecular characterization of zebrafish embryogenesis via DNA microarrays and multiplatform time course metabolomics studies. J. Proteome Res., 10(11), 5102–5117. https://doi.org/10.1021/pr2005549

19 Karakach, T., Flight, R., Douglas, S. & Wentzell, P. (2010). An introduction to DNA microarrays for gene expression analysis. Chemometrics and Intelligent Laboratory Systems, 104(1). https://doi.org/10.1016/j.chemolab.2010.04.003

20 uperlovi-Culf, M., Belacel, N., Culf, A. S., Chute, I. C., Ouellette, R. J., Burton, I. W., Karakach, T. K. & Walter, J. A. (2009). NMR metabolic analysis of samples using fuzzy K-means clustering. Magnetic Resonance in Chemistry, 47(SUPPL. 1). https://doi.org/10.1002/mrc.2502

21 Karakach, T., Wentzell, P. & Walter, J. (2009). Characterization of the measurement error structure in 1D 1H NMR data for metabolomics studies. Anal. Chim. Acta, 636(2), 163–174. https://doi.org/10.1016/j.aca.2009.01.048

22 Karakach, T. K., Knight, R., Lenz, E. M., Viant, M. R. & Walter, J. A. (2009). Multivariate curve resolution of time course 1H NMR metabolomics data. Magnetic Resonance in Chemistry, 47(SUPPL. 1), S105–S117. https://doi.org/10.1002/mrc.2535

23 Viant, M. R., Bearden, D. W. D., Bundy, J. J. G., Burton, I. I. W., Collette, T. W. T., Ekman, D. R. D., Ezernieks, V., Karakach, T. K. T., Lin, C. Y. C., Rochfort, S., de Ropp, J. S., Teng, Q., Tjeerdema, R. R. S., Walter, J. A. J., Wu, H., De Ropp, J., Teng, Q., Tjeerdema, R. R. S., Walter, J. A. J. & Huifeng, W. (2008). International NMR-based environmental metabolomics intercomparison exercise. Environmental Science & Technology, 43(1), 219–225. https://doi.org/10.1021/es802198z

24 Karakach, T., Flight, R. & Wentzell, P. (2007). Bootstrap method for the estimation of measurement uncertainty in spotted dual-color DNA microarrays. Anal. Bioanal. Chem., 389(7-8), 2125–2141. https://doi.org/10.1007/s00216-007-1617-0

25 Karakach, T. & Wentzell, P. (2007). Methods for estimating and mitigating errors in spotted, dual-color DNA microarrays. OMICS A Journal of Integrative Biology, 11(2). https://doi.org/10.1089/omi.2007.0008

26 Wentzell, P., Karakach, T., Roy, S., Juanita, M., Allen, C., Werner-Washburne, M., Martinez, M. J., Allen, C. & Werner-Washburne, M. (2006). Multivariate curve resolution of time course microarray data. BMC Bioinformatics, 7, 343. https://doi.org/10.1186/1471-2105-7-343

27 Ewart, K., Belanger, J., Williams, J., Karakach, T., Penny, S., Tsoi, S., Richards, R. & Douglas, S. (2005). Identification of genes differentially expressed in Atlantic salmon (Salmo salar) in response to infection by Aeromonas salmonicida using cDNA microarray technology. Developmental and Comparative Immunology, 29(4). https://doi.org/10.1016/j.dci.2004.08.004

28 Wentzell, P. & Karakach, T. (2005). DNA microarrays: Is there a role for analytical chemistry? Analyst, 130(10). https://doi.org/10.1039/b508677a

Invited Conference Proceedings

1 Karakach, T. K. (2019). Lessons from Wilms Tumor Multi-omics Data Integration: obtaining biologically meaningful information, In Child health research days, Winnipeg, MB, Canada.

2 Karakach, T. K. (2012a). Bioinformatics for Functional Genomics: deciphering systems biochemistry, In South african national bioinformatics institute invited speaker series, Cape Town, SA.

3 Karakach, T. K. (2012b). Maximum Likelihood PCA vs. Variance Stabilization for Metabolomics Data Analysis: a comparative study, In 2nd african-european conference on chemometrics, Stellenbosch, South Africa.

4 Karakach, T. K. (2011a). Bioinformatics for functional genomics, In University of louiseville department of bioinformatics seminar series, Louiseville, Kentucky, USA.

5 Karakach, T. K. (2011b). Experimental design and data analysis issues in the search for cancer biomarkers, In Stony brook university school of medicine, department of pathology grand rounds, Stony Brook, NY, USA.

6 Karakach, T. K., Burton, I. W., Penny, S. & Ebanks, R. (2011). Fusion of temporal proteomics, metabolomics and transcriptomics measurements: chemometrics insights

into systems biology, In 50th eastern analytical symposium and exposition, Somerset, New Jersey, USA.

7 Karakach, T. K. (2008). Analysis of time course metabolomics data by multivariate curve resolution, In Atlantic omics symposium and expo, Moncton, NB, Canada.

Books and Chapters

1 Merkley, N., Burton, I., Karakach, T. & T. Syvitski, R. (2013). Magnetic Resonance Technologies: Molecules to Medicine (M. Kulka, Ed.). In M. Kulka (Ed.), Using old solutions to new problems - natural drug discovery in the 21st century. London, InTechOpen Limited. `https://doi.org/10.5772/54231`

Student Training and Mentoring

Ph.D. Students

2019 – ····   Lucien Cayer: University of Manitoba, Department of Food and Human Nutritional Sciences, Winnipeg, MB, CANADA.

2017 – 2021   Federico Taverna: Vlaams Instituut vor Biotechnologie (VIB), Center for Cancer Biology, KU Leuven, VIB-KU Leuven, Department of Oncology, Leuven, BELGIUM.

M.Sc. Students

2021 – ····   Maddison Hodgins: Dalhousie University, Department of Pharmacology, Halifax, NS, CANADA.

Co-op and Summer Students

2021   Fabian Bong: [Dalhousie University, Department of Chemistry]; Department of Pharmacology, Faculty of Medicine, Halifax, NS Canada.

    Hannah Harquail: [Dalhousie University, Biomedical Sciences Programm]; Department of Pharmacology, Faculty of Medicine, Halifax, NS Canada.

2015   Melanie MacArthur: [Dalhousie University, Department of Chemistry]; National Research Council of Canada, Institute for Marine Biosciences, NRC-IMB, Department of Functional Genomics, Halifax, NS Canada.

2010   Mohan Thomas: [University of Waterloo, Faculty of Engineering]; National Research Council of Canada, Institute for Marine Biosciences, NRC-IMB, Department of Functional Genomics, Halifax, NS Canada.

    Melanie Wong: [University of Waterloo, Faculty of Engineering]; National Research Council of Canada, Institute for Marine Biosciences, NRC-IMB, Department of Functional Genomics, Halifax, NS Canada.

2009   Zoe Migicovski: [Acadia University, Department of Biology]; National Research Council of Canada, Institute for Marine Biosciences, NRC-IMB, Department of Functional Genomics, Halifax, NS Canada.

    Chloe Mitton: [Dalhousie University, Department of Biology]; National Research Council of Canada, Institute for Marine Biosciences, NRC-IMB, Department of Functional Genomics, Halifax, NS Canada.

Student Training and Mentoring (continued)

Ping Lee: [Dalhousie University, Department of Physics]; National Research Council of Canada, Institute for Marine Biosciences, NRC-IMB, Department of Functional Genomics, Halifax, NS Canada.