Curriculum vitae

RAJINI RAO, Ph.D.

18 October, 2013

DEMOGRAPHIC INFORMATION

CURRENT APPOINTMENT

Professor, Department of Physiology
Director, Graduate Program in Cellular & Molecular Medicine
The Johns Hopkins University
School of Medicine

PERSONAL DATA

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Date of Birth: April 3, 1962

EDUCATION & TRAINING

INSTITUTION AND LOCATION	DEGREE (*if applicable*)	YEAR(s)	FIELD OF STUDY
Mount Carmel College, Bangalore, India	B.Sc.	1980-1983	Chemistry, Biology
University of Rochester, Rochester, NY	Ph.D.	1983-1988	Biochemistry
Yale University, New Haven, CT	Postdoctoral	1988-1992	Genetics

PROFESSIONAL EXPERIENCE

1984-1985	Teaching Assistant in the Department of Biochemistry, University of Rochester, for *General Biochemistry*, *Advanced Biochemistry*, and *Proteins and Enzymes*
1988-1992	Postdoctoral Fellow with Dr. Carolyn W. Slayman, Department of Genetics, Yale University School of Medicine, New Haven, CT
1992-1993	Associate Research Scientist, Department of Genetics, Yale University School of Medicine
1993-1998	Assistant Professor, Department of Physiology, Johns Hopkins University School of Medicine
1998-2004	Associate Professor, Department of Physiology, Johns Hopkins University School of Medicine
2004-current	Professor, Department of Physiology, Johns Hopkins University School of Medicine
2008-current	Director, Graduate Training Program in Cellular & Molecular Medicine

PERSONAL STATEMENT

I have 30 years of experience working with **ion transporters**, including H^+-ATPases, Ca^{2+}-ATPases and Na^+/H^+ exchangers. My research focus is on the discovery of new ion transporters and their physiological roles in human health and disease. My laboratory was the first to define the Golgi/Secretory Pathway Ca^{2+}, Mn^{2+}-ATPases (SPCA) and propose their assignment to a new family based on their unique biochemical and phylogenetic properties. Our discovery of an oncogenic role for SPCA2 in breast cancer, mediated by an unconventional mechanism of signaling to Ca^{2+} channels, opens a new chapter in the study of this isoform. We were the first to clone and recognize the intracellular $Na^+(K^+)/H^+$ exchangers as a separate group from the well-known plasma membrane NHE. Currently, we combine use of yeast and astrocyte models to understand the role of NHE6 and NHE9 in neurological disease, including autism. More recently, we identified a new family of cation/H^+ antiporters that are distantly related to bacterial NhaA; our findings implicate a role for human NHA2 in sodium lithium countertransport activity linked to essential hypertension. We also investigate the cellular pathway of ion-mediated fungal (*C. albicans*) cell death and target this pathway, including the V-type H^+-ATPase, for the development of antimycotic drugs. We are exploring the use of the anti-arrhythmic drug amiodarone in antifungal therapy, particularly of azole-resistant fungi.

My academic activities are divided equally between **education**, **mentoring** and **research**. As the Director of the Graduate Program in Cellular & Molecular Medicine, I oversee a multi-departmental training program that includes approximately 130 faculty mentors and 150 graduate students (Ph.D., M.D./Ph.D. and D.V.M/Ph.D.). Our goal is to provide rigorous training in medical research as it applies to human disease. I am also a faculty mentor in other graduate programs at the School of Medicine (Biochemistry, Cell & Molecular Biology, and Cellular & Molecular Physiology) where I teach, direct courses and hold small group discussions. I instruct first year Medical students in cellular physiology. In my own lab, I have mentored **over 20 graduate students and postdoctoral fellows**, many of whom have won national awards and independent fellowships. Two of my graduate students won the prestigious Young Investigator Award at Johns Hopkins. Several of my former students and postdocs are at independent academic faculty positions or in industry.

As part of a long standing effort to improve the **representation of minority groups** at all levels of academia, I have participated in the following (partial list): Summer Internship Program Admissions Committee (Diversity Program; 2007-current), NIH Review Panel for Predoctoral Fellowships (Minorities and Disabilities; 2008); *ABRCMS* conference in Florida, Poster Judge (2008); NIH Review Panel *MBRS* program (2010) and hosted at least one underrepresented minority student in my laboratory every year. Many of these students have gone on to attend prestigious undergraduate, graduate or medical schools, including Johns Hopkins University and Harvard.

RESEARCH ACTIVITIES

PEER-REVIEWED PUBLICATIONS

1. Holzschu, D., Principio, L., Conklin, K.T., Hickey, D.R., Short, S., Rao, R., McLendon, G., and Sherman, F. (1987)
   Replacement of the invariant lysine 77 by arginine in yeast iso-1-cytochrome *c* results in enhanced and normal activities *in vitro* and *in vivo*.
   J. Biol. Chem. **262**, 7125-7131
2. Rao, R., Perlin, D.S., and Senior, A.E. (1987)
   The defective proton-ATPase of *uncA* mutants of *Escherichia coli*: ATP binding and ATP-induced conformational change in mutant alpha subunits.
   Arch. Biochem. Biophys. **255**, 309-315
3. Rao, R., and Senior, A.E. (1987)
   The properties of hybrid F_1-ATPase enzymes suggest that a cyclical catalytic mechanism involving three catalytic sites occurs.
   J. Biol. Chem. **262**, 17450-17454

4. Rao, R., Al-Shawi, M.K., and Senior, A.E. (1988)
Trinitrophenyl-ATP and -ADP bind to a single nucleotide site on isolated beta subunit of *Escherichia coli* F_1-ATPase. In vitro assembly of F_1-subunits requires occupancy of the nucleotide binding site on beta subunit by nucleotide triphosphate.
J. Biol. Chem. **263**, 5569-5573

5. Rao, R., Cunningham, D., Cross, R.L., and Senior, A.E. (1988)
Pyridoxal 5'-diphospho-5'-adenosine binds at a single site on isolated alpha subunit from *Escherichia coli* F_1-ATPase and specifically reacts with lysine 201.
J. Biol. Chem. **263**, 5640-5645

6. Rao, R., Pagan, J., and Senior, A.E. (1988)
Directed mutagenesis of the strongly conserved lysine 175 in the proposed nucleotide binding domain of alpha subunit from *Escherichia coli* F_1-ATPase.
J. Biol. Chem. **263**, 15957-15963

7. Nakamoto, R.K., Rao. R., and Slayman, C.W. (1991)
Expression of the yeast plasma membrane H^+-ATPase in secretory vesicles. A new strategy for directed mutagenesis.
J. Biol. Chem. **266**, 7940-7949

8. Rao, R., and Slayman, C.W. (1992)
Mutagenesis of the yeast plasma membrane H^+-ATPase. A novel expression system.
Biophys. J. **62**, 228-237

9. Rao, R., Nakamoto, R.K., Verjovski-Almeida, S., and Slayman, C.W. (1992)
Structure and function of the yeast plasma membrane H^+-ATPase.
Annals of the N.Y. Acad. Sci. **671**, 195-203

10. Rao, R., and Slayman, C.W. (1993)
Mutagenesis of conserved amino acids in the phosphorylation domain of the yeast plasma membrane H^+-ATPase. Effects on structure and function.
J. Biol. Chem. **268**, 6708-6713

11. Rao, R., Drummond-Barbosa, D., and Slayman, C.W. (1993)
Transcriptional regulation by glucose of the yeast *PMA1* gene encoding the plasma membrane H^+-ATPase.
Yeast **9**, 1075-1084

12. Sorin, A., Rosas, G. and Rao, R. (1997)
PMR1, a Ca^{2+}-ATPase in yeast Golgi, has properties distinct from sarco/endoplasmic reticulum and plasma membrane calcium pumps.
J. Biol. Chem. **272**, 9895-9901

13. Nass, R., Cunningham, K. W., and Rao, R. (1997)
Intracellular sequestration of sodium by a novel Na^+/H^+ exchanger in yeast is enhanced by mutations in the plasma membrane H^+-ATPase. Insights into mechanisms of Na^+ tolerance.
J. Biol. Chem. **272**, 26145-26152

14. Nakamoto, R.K., Verjovski-Almeida, S., Allen, K.E., Ambesi, A., Rao, R., and Slayman, C.W. (1998)
Substitutions of aspartate 378 in the phosphorylation domain of the yeast PMA1 H^+-ATPase disrupt protein folding and biogenesis.
J. Biol. Chem. **273**, 7338-7344

15. Nass, R., and Rao, R. (1998)
Novel localization of a Na^+/H^+ exchanger in a late endosomal compartment of yeast. Implications for vacuole biogenesis.
J. Biol. Chem. **273**, 21054-21060

16. Gaxiola, R.A., Rao, R., Sherman, A., Grisafi, P., Alper, S., and Fink, G.R. (1999)
The *Arabidopsis thaliana* proton transporters, AtNhx1 and Avp1, can function in cation detoxification in yeast.
Proc. Natl. Acad. Sci. USA **96**, 1480-1485

17. Marchi, V., Sorin, A., Wei, Y., and Rao, R. (1999)
Induction of vacuolar Ca^{2+}-ATPase and H^+/Ca^{2+} exchange activity in yeast mutants lacking Pmr1, the Golgi Ca^{2+}-ATPase.

FEBS Lett. **454**, 181-186

18. Nass, R., and Rao, R. (1999)
    The yeast endosomal Na^+/H^+ Exchanger, Nhx1, confers osmotolerance following acute hypertonic shock. *Microbiology* **145**, 3221-3228
19. Wei, Y., Marchi, V., Wang, R., and Rao, R. (1999)
    Role of the EF-hand motif in ion selectivity and transport by Pmr1, the yeast Golgi Ca^{2+}-ATPase. *Biochemistry* **38**, 14534-14541
20. Wei, Y., Chen, J., Rosas, G., Tompkins, D.A., Holt, P.A., and Rao, R. (2000)
    Phenotypic screening of mutations in Pmr1, the yeast secretory pathway/Golgi Ca^{2+}/ Mn^{2+}-ATPase, reveals residues critical for ion selectivity and transport. *J. Biol. Chem.* **275**, 23927-23932
21. Mandal, D., Woolf, T.B., and Rao, R. (2000)
    Manganese selectivity of the yeast secretory pathway ion pump, Pmr1, is defined by residue Q783 in transmembrane segment 6. Residue 778 is essential for transport. *J. Biol. Chem.* **275**, 23933-23938
22. Wells, K.M., and Rao, R. (2001)
    The yeast Na^+/H^+ exchanger Nhx1 is an N-linked glycoprotein. Topological implications. *J. Biol. Chem*. **276**, 3401-3407
23. Ton, V.-K., Mandal, D., Vahadji, C., and Rao, R. (2002)
    Functional Expression in Yeast of the Human Secretory Pathway Ca^{2+}/ Mn^{2+}--ATPase defective in Hailey Hailey disease. *J. Biol. Chem*. **277**, 6422-6427
24. Brett, C.L., Wei, Y., Donowitz, M., and Rao, R. (2002)
    Human Na^+/H^+ Exchanger NHE6 is Found in the Recycling Endosomes of Cells, Not Mitochondria. *Am J Physiol Cell Physiol.* **282**, C1031-1041
25. Cronin, S.R., Rao, R., Hampton, R.Y. (2002)
    Cod1p/Spf1p is a P-type ATPase involved in ER function and Ca^{2+} homeostasis. *J. Cell Biol.* **157**, 1017-1028
26. Sen Gupta, S., Ton, V.K., Beaudry, V., Rulli, S., Cunningham, K.W., and Rao, R. (2003)
    Antifungal activity of amiodarone is mediated by disruption of calcium homeostasis. *J. Biol. Chem*. **278**, 28831-28839
27. Mandal, D., Rulli, S. and Rao, R. (2003)
    Packing interactions between transmembrane helices alter ion selectivity of the yeast Golgi Ca^{2+}/Mn^{2+}-ATPase Pmr1. *J. Biol. Chem*. **278**, 35292-35298
28. Ali, R., Mukherjee, S., Brett, C.L., and Rao, R. (2004)
    Inhibition of sodium/proton exchange by a Rab-GTPase activating protein regulates endosomal traffic in yeast. *J. Biol. Chem.* **279,** 4498-4506
29. Ton, V.K., and Rao, R. (2004)
    Expression of Hailey Hailey disease mutations in yeast. *J. Invest. Dermatol*. **23**, 1192-4.
30. Brett, C.L., Tukaye, D.N., Mukherjee, S., Rao, R. (2005)
    The Yeast Endosomal $Na^+(K^+)/H^+$ Exchanger Nhx1 Regulates Cellular pH to Control Vesicle Trafficking. *Mol Biol. Cell*. **16**, 1396-405
31. Xiang, M., Mohamalawari, D., Rao, R. (2005)
    A novel isoform of the secretory pathway Ca^{2+}, Mn^{2+}-ATPase, hSPCA2, has unusual properties and is expressed in brain. *J. Biol. Chem*. **280**, 11608-11614
32. Brett, C.L., Donowitz, M. and Rao, R. (2006)
    Does the proteome encode organellar pH? *FEBS Lett*. **580**, 717-719
33. Mukherjee, S., Kallay, L., Brett, C.L. and Rao, R. (2006)
    Mutational analysis of the intramembranous H10 loop of yeast Nhx1 reveals a critical role in ion homeostasis and vesicle trafficking.

Biochem J. **398**, 97-105
34. Hill, J., Brett, C.L., Chyou, A., Kallay, L.M., Sakaguchi, M., Rao, R. and Gillespie, P.G. (2006)
Vestibular hair cells control pH with $Na^+(K^+)/H^+$ exchangers NHE6 and NHE9.
J. Neuroscience. **26**, 9944-9955
35. Yadav, J., Muend, S., Zhang, Y., and Rao, R. (2007)
A Phenomics Approach in Yeast Links Proton and Calcium Pump Function in the Golgi.
Mol Biol Cell. **18**, 1480-1489
36. Xiang, M., Feng, M., Muend, S., and Rao R. (2007)
A human Na^+/H^+ antiporter sharing evolutionary origins with bacterial NhaA may be a candidate gene for essential hypertension.
Proc Natl Acad Sci U S A. **104**:18677-81
37. Zhang, Y.Q., and Rao, R. (2007)
Global disruption of cell cycle progression and nutrient response by the antifungal agent amiodarone.
J. Biol. Chem. **282**:37844-53
38. Muend, S., and Rao, R. (2008)
Fungicidal activity of amiodarone is tightly coupled to calcium influx.
FEMS Yeast Research **8**:425-431.
39. Faddy HM, Smart CE, Xu R, Lee GY, Kenny PA, Feng M, Rao R, Brown MA, Bissell MJ, Roberts-Thomson SJ, Monteith GR. (2008)
Localization of plasma membrane and secretory calcium pumps in the mammary gland.
Biochem Biophys Res Commun **369**: 977-87
40. Maresova L, Muend S, Zhang YQ, Synchrova H and Rao R. (2009)
Membrane hyperpolarization drives cation influx and fungicidal activity of amiodarone.
J. Biol. Chem. **284**: 2795-802.
41. Gamarra, S., Rocha, E.M., Zhang, Y.Q., Park, S., Rao, R., Perlin, D.S. (2010)
Mechanism of the synergistic effect of amiodarone and fluconazole in Candida albicans.
Antimicrob Agents Chemother. **54**, 1753-61.
42. Schushan, M., Xiang, M., Bogomiakov, P., Padan, E., Rao, R. and Ben-Tal, N. (2010)
Model-guided mutagenesis drives functional studies of human NHA2, implicated in hypertension.
J. Mol. Biol. **396**, 1181-1196
43. Zhang, Y.Q., Gamarra, S., Garcia-Effron, G., Park, S., Perlin, D.S. and Rao R. (2010)
Requirement for ergosterol in V-ATPase function underlies antifungal activity of azole drugs.
PLoS Pathog. **6**, e1000939
44. Rao, A., Zhang, Y.Q., Muend, S. and Rao, R. (2010)
Mechanism of Antifungal Activity of Terpenoid Phenols Resembles Calcium Stress and Inhibition of the TOR Pathway.
Antimicrob Agents Chemother **54**, 5062-9.
45. Feng, M., Grice, D., Faddy, H.M., Ngyuen, N., Leitch, S., Wang, Y., Muend, S., Kenny, P.A., Sukumar, S., Roberts-Thomson, S., Monteith, G., and Rao, R. (2010)
Store-independent activation of Orai1 by SPCA2 in mammary tumors.
Cell **143**, 84-98.
46. Leitch, S., Feng, M., Muend, S., Braiterman, L., Hubbard, A. and Rao, R. (2011)
Vesicular distribution of secretory pathway Ca^{2+}-ATPase isoform 1 (SPCA1) and a role in manganese detoxification in liver-derived polarized cells.
Biometals **24**, 159-170.
47. Brett, C.L., Kallay, L.M., Hua, Z., Green, R., Chyou, A., Zhang, Y.Q., Graham, T.R., Donowitz, M., and Rao, R. (2011) Genome wide analysis reveals the vacuolar pH-stat of *Saccharomyces cerevisiae*.
PLoS ONE. **6**, e17619.
48. Chanroj S., Lu, Y., Padmanaban, S., Nanatani, K., Uozumi, N., Rao, R., Sze H. (2011) Plant specific cation/H^+ exchanger 17 and its homologs are endomembrane K^+ transporters with roles in protein sorting.
J. Biol. Chem. **286**, 33931-41.
49. Kallay, L.M., Brett, C.L., Tukaye, D.N., Wemmer, M.A., Chyou, A., Odorizzi, G., Rao R. (2011)
The endosomal $Na^+(K^+)/H^+$ exchanger Nhx1functions independently and downstream of the multivesicular body pathway.
J Biol Chem. **286**, 44067-77

50. Kondapalli, K.C., Kallay, L., Muszelik, M., and Rao, R. (2012)
Uncoventional chemiosmotic coupling of NHA2, a mammalian Na^+/H^+ antiporter, to a plasma membrane H^+ gradient.
J. Biol. Chem. **287**: 36239-50.
51. Shim, J.S. Rao, R., Beebe K., Neckers L., Han I., Nahta R., and Liu J.O. (2012)
Selective inhibition of HER-2 positive breast cancer cells by the HIV protease inhibitor nelfinavir.
J Natl Cancer Inst **104**,1576-90.
52. Cross, B., Hack, A., Reinhardt, T.A., and Rao, R. (2013)
SPCA2 regulates Orai1 trafficking and store independent entry in a model of lactation.
PLoS ONE **8**, e67348
53. Patenaude, C., Zhang, Yongqiang, Cormack, B., Kohler, J., and Rao, R. (2013)
Essential role for vacuolar acidification in *Candida albicans* virulence.
J. Biol. Chem. **288**, 26256-64.
54. Kondapalli, K.C., Hack, A., Schushan, M. Landau, M., Ben-Tal, N. and Rao, R. (2013)
Functional evaluation of autism associated mutations in NHE9.
Nat. Commun. **4**, 2510. doi: 10.1038/ncomms3510.

INVITED REVIEWS

55. Nakamoto, R.K., Rao, R., and Slayman, C.W. (1989)
Transmembrane segments of the P-type cation-transporting ATPases: a comparative study.
Annals of the N.Y. Acad. Sci. **574**, 165-179
56. Rao, R., Nakamoto, R.K., and Slayman, C.W. (1989)
The nucleotide binding site of the plasma membrane H^+-ATPase of *Neurospora crassa*: a comparison with other P-type ATPases.
In *Ion Transport*. D. Keeling, and C. Benham, editors. Academic Press, N.Y. 35-53
57. Padmanabha, K.P., Petrov, V., Ambesi, A., Rao, R., and Slayman, C.W. (1994)
Structural features of the plasma membrane H^+-ATPase
Membrane Transport in Plants and Fungi: Molecular Mechanisms and Control. Symposia of the Society for Experimental Biology **XLVII**, 33-42; Blatt, M.R., Leigh, R.A., Sanders, D. (eds). The Company of Biologists Ltd. Cambridge UK
58. Ton, V.-K. and Rao, R. (2004)
Functional expression of heterologous proteins in yeast: insights into calcium signaling and Ca^{2+}-transporting ATPases.
Am. J. Physiol. Cell Physiol. **287**, C580-589
59. Brett, C. L., Donowitz, M. and Rao, R. (2005)
The evolutionary origins of eukaryotic Na^+/H^+ exchangers
Am. J. Physiol. Cell Physiol. **288**, C223-239
60. Zhang, Y.Q., and Rao, R. (2008)
A spoke in the wheel: calcium spikes disrupt yeast cell cycle.
Cell Cycle **7**:870-873.
61. Zhang, Y.Q. and Rao, R. (2010)
Beyond ergosterol: linking pH to antifungal mechanisms.
Virulence 1(6):551-4.
62. Zhang, Y.Q. and Rao, R. (2012)
The V-ATPase as an antifungal target.
Current Protein and Peptide Science 12(2):134-40.
63. Zhang Y, Muend S, Rao R. (2012)
Dysregulation of ion homeostasis by antifungal agents.
Frontiers in Microbiology (minireview) 3(133).
64. Feng, M. and Rao, R. (2013)
New insights into store-independent Ca^{2+} entry: Secretory Pathway Calcium ATPase 2 in normal physiology and cancer.
Int. J. Oral. Sci. doi: 10.1038/ijos.2013.23.

65. Cross, B.M., Breitwieser, G., Reinhardt, T. and Rao, R.
Cellular Ca^{2+} dynamics in lactation and breast cancer: From physiology to pathophysiology
Am. J. Physiol. Cell Physiol. (submitted)

BOOK CHAPTERS

66. Rao, R., and Slayman, C.W. (1996)
The fungal P-ATPases: a functionally diverse family of cation pumps.
The Mycota **Vol. IV**, 29-56 (R. Brambl and G.A. Marzluf, eds. Springer-Verlag, Berlin)
67. Rao, R., and Inesi, G. (2004)
Inherited disorders of Calcium ATPases: Role in health and disease
Membrane Transport Diseases: Molecular basis of inherited transport defects. (S. Broer and C.A. Wagner, eds. Kluwer Academic/Plenum Publishers)

EXTRAMURAL SPONSORSHIP

CURRENT

Title: Training Program in Cellular & Molecular Medicine
Principal Investigator: Rajini Rao, Ph.D.
Agency: National Institutes of General Medical Sciences (NIGMS)
Type: T32
Period: July 1, 2010-June 30, 2015

Title: Secretory Pathway Calcium and Manganese Pumps
Principal Investigator: Rajini Rao, Ph.D.
Agency: National Institute of General Medical Sciences (NIGMS)
Type: R01
Period: December 1, 2011- November 30, 2015

PENDING

Title: Transport mechanism and renal function of a newly recognized Na^+/H^+ Exchanger
Principal Investigator: Rajini Rao, Ph.D.
Agency: National Institute of Diabetes and Digestive and Kidney Disease (NIDDK)
Type: R01
Period: June 1, 2008-March 31, 2019 (renewal application)

Title: Can Endosomal pH correct Alzheimer's pathologies?
Principal Investigator: Rajini Rao, Ph.D.
Agency: Bright Focus Foundation
Type: Alzheimer's Disease Research Grant
Period: July 1, 2014-June 30, 2017

PREVIOUS

Title: Cellular Basis for the Antifungal Activity of Amiodarone
Principal Investigator: Rajini Rao, Ph.D.
Agency: National Institutes of Health
Type: R01
Period: July 1, 2006-June 30, 2011

Title: The NhaA Na^+/H^+ antiporters: structure and evolutionary-bioinformatic based study
Principal Investigators: Etana Padan, Ph.D. (Israel) and Rajini Rao, Ph.D. (USA)
Agency: United States-Israel Binational Science Foundation (BSF)
Type: Research Grant

Title: Mechanisms of Ion Selection and Transport in P-type ATPases
Principal Investigator: Rajini Rao, Ph.D. (40% effort)
Agency: National Institutes of General Medical Sciences (NIGMS)
Type and ID number: R01 GM62142

Title: Endosomal Exchangers from Yeast and Human: Role and Regulation
Principal Investigator: Rajini Rao, Ph.D. (30 % effort)
Agency: National Institutes of Health (NIDDK)
Type and ID number: R01 DK54214

Title: Cellular and Molecular Properties of the Human Secretory Pathway Calcium Pumps
Principal Investigator: Rajini Rao, Ph.D. (5% effort)
Agency: American Heart Association Mid-Atlantic Affiliate
Type and ID number: Grant-In-Aid

Title: Molecular Basis of Ion Transport in Calcium and Proton Pumps
Principal Investigator: Rajini Rao
Agency: American Cancer Society
Type and ID number: Institutional Research Grant (IRG 11-33)

Title: Molecular Mechanisms of Cation Transport in Yeast
Principal Investigator: Rajini Rao
Agency: American Cancer Society
Type and ID number: Junior Faculty Award (JFRA 538)

Title: Molecular Analysis of Calcium Pumps
Principal Investigator: Rajini Rao, Ph.D.
Agency: National American Heart Association
Type and ID number: Grant-In-Aid (GIA 95012290)

Title: Cellular and Molecular Role of Endosomal Na^+/H^+ Exchangers
Principal Investigator: Rajini Rao, Ph.D.
Agency: National Institute of Diabetes and Digestive and Kidney Disease (NIDDK)
Type: R01 DK54214

Title: Molecular Basis for Selectivity and Transport in Ion Pumps
Principal Investigator: Rajini Rao, Ph.D.
Agency: National Institutes of General Medical Sciences (NIGMS)
Type: R01 GM52414

EDUCATIONAL ACTIVITIES

GRADUATE PROGRAMS

Biochemistry, Cell & Molecular Biology (BCMB)
Role: Faculty Mentor (1994-current), Admissions Committee, Course Director (2003-2011)
Cellular & Molecular Medicine (CMM)
Role: Faculty Mentor (1999-current), Policy Committee (2002-2007)
Director (2008-current)
Cellular & Molecular Physiology (CMP)
Role: Faculty Mentor (1994-current)

TEACHING

GRADUATE & MEDICAL COURSES

BCMB *Pathways and Regulation* Core Module Course
Description: Core course for 1st year graduate students/16 lecture slots/approx. 100 students
Role: Course Director (2003-2011) and Lecturer (3 lectures)

CMP/Pharmacology, BCMB and CMM Discussion Series
Time Commitment: 3-4 journal clubs/year
Role: Faculty Leader (1999-current)

BCMB *Core Discussion* Series
Description: classes were twice/week throughout the academic year
Role: Course Director (1999-2003)

BCMB *Graduate Biochemistry and Cell Biology*
Time Commitment: 4 lectures/approx. 100 students
Role: Lecturer (1998-2003)

CMM *Human Body*
Time Commitment: 1 lecture/approx. 20 students
Role: Lecturer (2008-current)

Medical School *Molecules and Cells* (1st year course)
Time: Commitment: 2 lectures, small group discussions (daily for ca. 2.5 weeks)/approx. 150 students
Role: Lecturer, Faculty Leader (1995-current)

Medical School *Organ Systems* (1st year course)
Time Commitment: Journal Clubs, small group discussions in Renal and GI section
Role: Faculty Leader (1995-2011)

Biomedical Engineering *Horizons in biological calcium and voltage signaling* (Elective Course)
Time Commitment: 2 journal clubs (3 hours)
Role: Faculty Leader (2013-current)

MENTORING

THESIS ADVISOR

Richard Nass	(1994-98) Cellular and Molecular Physiology (CMP) Graduate program, currently Associate Professor, Indiana University.
Christopher L. Brett	(1999-2005) Cellular and Molecular Medicine (CMM) Graduate program, *American Heart Association PreDoctoral Fellowship Awardee* (2002-2004); *David Israel Macht award* of the Young Investigators Day, Johns Hopkins. Currently Assistant Professor and Canada Research Chair Nominee, Department of Biology, Concordia Univ. Montreal.
Van-Khue Ton	(2000-2005) Biochemistry Cell & Molecular Biology (BCMB) Graduate program, *Winner of 2002 Graduate Student Poster Award in 2nd-3rd year category, Organizer of 2003 Hopkins Yeast Meetings (monthly research presentations).* Currently Cardiology Fellow, Johns Hopkins Hospital.
Sabina Muend	(2004-2009) Cellular & Molecular Physiology (CMP) Graduate Program, Currently Aerospace Physiologist, United States Navy.
Mingye Feng	(2005-2011) Cellular & Molecular Physiology (CMP) Graduate Program, *AHA Predoctoral Fellowship Awardee* (2008-2010), *Martin & Carol Macht Young Investigator Awardee* (2011), Currently Postdoctoral Fellow at Stanford Univ.
Brandie Cross	(2008-2013) Biochem. Cell & Mol. Biol (BCMB) Graduate Program, *Kelly Young Scholar* (2008); current Chief Scientific Officer of The Pot Lab, a non-profit cooperative of scientists supporting medical products, services and scientific research into Cannabis
Anniesha Hack	(2008-2013) Cellular & Molecular Medicine (CMM) Graduate Program, *APS Porter Fellow* (2010-2012); currently Clinical Research Scientist at Memorial Sloan Kettering Cancer Center (NY).
Cassandra Patenaude	(2011-current) Biochem. Cell & Mol. Biol (BCMB) Graduate Program
Hari Prasad	(2012-current) Cellular & Molecular Medicine (CMM) Graduate Program; *Fullbright Fellow* (current)
Donna Dang	(2013-current) Cellular & Molecular Medicine (CMM) Graduate Program

VISITING STUDENTS

Runsheng Wang, M.D.	(1994) Visiting student from China; *World Health Organization Scholarship*
Stephen Cronin	(2001) Visiting Ph.D. candidate from U.C. San Diego
Soma SenGupta, Ph.D.	(2002) Visiting Medical student from Cambridge, UK; *Burroughs Wellcome Scholarship*
Sam Kuruvilla	(2003) Visiting Ph.D. candidate from SPIC, India; *UNESCO/American Society for Microbiology Scholarship*
Barbara Stiller	(2008) Visiting Ph.D. candidate from University of Cologne, Germany
Uchenna Emeche	(2008-2009) Visiting Medical student from Case Western Reserve

MINORITY TRAINING/RECRUITMENT *Representative selection (approx. 1 URM student/summer)*

1995	Sonya Green (*MSIP* scholarship)

1999	LaTanja Watkins (*MSIP* scholarship)
2006-2007	Akunna Iheanacho (currently in CMP graduate program), Anselm Beach (currently at Harvard; supported by research supplement from NIGMS)
2007-current	Melinda Beale (volunteer trainee)
2007-current	Summer Internship Program Admissions Committee (Diversity Program)
2008	NIH Review Panel for Predoctoral Fellowships (Minorities and Disabilities)
2008	*ABRCMS* conference in Florida, Poster Judge
2010	NIH Review Panel *MBRS* program
2010-current	Jose Pablo Llongueras, Johns Hopkins Post-Baccalaureate program.

ORAL EXAM/THESIS COMMITTEE/THESIS READER: *Representative selection*

BCMB program:	Sean O'Hearn, Grace Naco, Jennifer Mehlman, Julia Romano, Kellie Cummings, Nurjana Bachman, Ed Brignole, Karen Pinco, Tom Sussan, Tillman Schneider-Poetsch
CMM program:	Nicholas Christoforou, Shafinaz Akhter, Anand Ganesan, Jennifer Hendersen
CMP program:	Jia Xu, Sang-Ho Kwon, Hongmei Yang, Tian Xu, Xiaoli Zhong
Pharmacology:	Jeff Shaman
Immunology:	Sara Pai, Vivian Weiss, Kenya Lemon
Biological Chemistry:	Elizabeth Petro, Lin Shen
Biology/Homewood:	Myriam Bonilla, Christine Birchwood, Emily Locke, Eric Muller, Kristine Funkhouser, Huynh Long
Bloomberg SPH	Edward Luk, Sunil Nayak, Amonrat Narauntar, Leah Rosenfeld
UMD at College Park	Ildoo Hwang, Xiyan Li, Salil Chanroj
UVA at Charlottesville	Christian Ketchum

POSTDOCTORAL FELLOWS

Gisele Rosas	(1995-97) Fellow, JHMI Department of Medicine (Cardiology)
Debjani Mandal	(1998-2001) Staff Scientist at the Indian Institute of Chemical Biology, Calcutta, India
Karen Wells	(1998-2000) *American Heart Association Postdoctoral fellow*, Instructor at University of Georgia and the Johns Hopkins University Department of Biology for Part-time studies.
Samuel Rulli	(2001-2002) Research Associate at the National Cancer Institute, Frederick, MD
Rashid Ali	(2001-2004) Research Associate at University of Connecticut, Storrs
Sanchita Mukherjee	(2001-2004) Staff Scientist at Mayo Clinic, Rochester MN
Jyoti Yadav	(2004-2006) Scientist, Institute of Genome and Integrative Biology, CSIR, India
Minghui Xiang	(2004-2009) Research Assistant Professor, UF College of Medicine, Jacksonville, FL
Sharon Leitch	(2008-2010) Senior Scientist, BD Biosciences, Molecular Division of Women's Health and Cancer
Laura Kallay	(2005-2010); Research Associate, Wilmer Eye Institute, Johns Hopkins University.
Yong Qiang Zhang	(2006-current); Senior Scientist (Research and Development) BD Diagnostics, Sparks, MD.
Kalyan Kondapalli	(2008-current); *American Heart Association Postdoctoral Fellow.*

UNDERGRADUATE STUDENTS: *Representative selection*

Alexander Sorin, Valerie Marchi (*Recipient of Johns Hopkins University Provost's Award for Research*), Patrick Andrew Holt, Sridaran Narayanan, Kimberly Young, Jenny Lin, LaTanja Watkins (*MSIP scholar*), Anthony Chyou (*Recipient of Johns Hopkins University Provost's Award for Research*), Michael Poli, Brooke Weckselblatt (*SIP scholar*, Bryn Mawr College), Sonya Murthy (Cedar Crest College), Lukman Solola (*SIP scholar,* Brooklyn College), Amitosh Singh (Johns Hopkins University), Melanie Muzelik (Wittenberg College), Pakinam Mekki (*SIP scholar,* Wagner College).

EDITORIAL ACTIVITIES:

Ad hoc reviewer for Nature, Journal of Cell Biology, Biochemistry, Microbiology, Molecular Biology of the Cell, Molecular Microbiology, J. Invest. Dermatology, J. Clinical Investigation, Plant Physiology, EMBO J., and others

Editorial Board Member, Journal of Biological Chemistry (2003-2008) and (2011-2016)
Editorial Advisory Board: ASBMB Today (2013-current)

ORGANIZATIONAL ACTIVITIES

INSTITUTIONAL

1994-1998	Medical School Council of the Johns Hopkins University
1995-2010	Young Investigators Day Awards Committee of the Johns Hopkins University
1998-2010	Admissions Committee and Student Progress Committee of Graduate Program in Cellular and Molecular Physiology (CMP)
2003	HIT Center Faculty Recruitment Committee
2002-2007	Policy Committee of the Graduate Program in Cellular and Molecular Medicine (CMM)
2003,2004,2005	Graduate Student Association Poster Competition Judge
2004-current	Admissions Committee of the Graduate Program in Biochemistry Cell and Molecular Biology (BCMB)
2005	IBBS Proposal Screening Committee
2007-current	Director, Center for Membrane Transport (IBBS Center)
2007-2011	Chair, Faculty Search Committee, Physiology department
2007-2009	Member, Faculty Search Committee, Center for Sensory Biology (IBBS Center)
2010-2012	Member, Faculty Search Committee, Center for Chemoprotection (IBBS Center)
2013	Chair, committee to review

PROFESSIONAL SOCIETIES

Member	Federation of American Society of Experimental Biology (FASEB), Biophysical Society (BP), American Society for Cell Biology (ASCB), American Association of Science (AAS), American Society for Biochemistry and Molecular Biology (ASBMB)
2006-2009	Elected Member of the Biophysical Society Council
2006-current	Elected Chair, Committee on Professional Opportunities for Women
2007-2008	Elected Member of the Executive Council, Biophysical Society
2009	Elected Chair, Nominating Committee, Biophysical Society
2010	Elected Member, Nominating Committee, Biophysical Society
2012	Nominated to run for President, Biophysical Society

OPPORTUNITIES FOR WOMEN

1998-2000	Day Care Committee of the Johns Hopkins University (*successful in instituting the first child care center at the medical campus*)
2002-current	Women's Leadership Council (WLC), Member and former Chair of Mentoring Committee
2006-current	Member & Elected Chair, Committee on Professional Development of Women (CPOW) Biophysical Society
2008	Moderator: "Getting paid and other negotiation skills" Biophysical Society Panel discussion
2013	Speaker, Conference on Excellence of Women in Science, Bern, Switzerland

CONFERENCES ORGANIZED

2000	Conference Organizer and Chair for the 2000 Mid-Atlantic Yeast Conference at the Homewood Campus of the Johns Hopkins University (June 2-4, 2000) featuring 150 registered participants, 30 platform talks and 40 poster presentations. My role as principal organizer was to set up the meeting web site, facilitate on-line registration, compile abstracts, receive payments, and organize meals, housing and entertainment, and coordinate the scientific sessions.
2002	Conference Organizer and Chair for the 20th Annual SMYTE (International Meeting on Yeast Transport and Bioenergetics) held at the Homewood Campus of the Johns Hopkins University (June 7-10, 2002) featuring 50 participants world-wide from 13 countries (25 talks and 12 poster presentations).
2007	Co-Chair, FASEB Summer Research Conference on Transport ATPases, Saxtons River, VT
2010	Conference Organizer and Chair, FASEB Summer Research Conference on Transport ATPases: From Molecules to Maladies, Snowmass Village, CO
2014	Vice-Chair, Gordon Research Conference on Membrane Transporters, Maine
2016	Chair, Gordon Research Conference on Membrane Transporters.

CONFERENCE SESSION CHAIR

1996, 2000, 2001	Session Chair for *Ion Motive ATPases* at the Annual Meeting of the Biophysical Society
2007	Session Chair and Organizer of Self-Assembled Session on *Metal Transport* at the Annual Meeting of the Biophysical Society
2007	Session chair, FASEB conference on Transport ATPases

ABSTRACT SORT

2001, 2002, 2006, 2008, 2009 Abstract Sort Committee for the Biophysical Society

ADVISORY COMMITTEES & REVIEW GROUPS

1998, 2000, 2008, 2010	Ad hoc reviewer for the NIH
2001-2005	Regular Member of Cardiovascular Physiology and Pharmacology Study Section of the National American Heart Association
2002-2007	Regular Member, NIH Study Section on Physical Biochemistry/Biophysics of Biological Membranes
2010-2012	Member, College of CSR Reviewers, NIH
2013-current	Member, Training Work Force and Development TWD-A Review Panel, NIH

SCIENCE OUTREACH

Twitter handle: @madamscientist
Blog: madamescientist.wordpress.com
Google+: google.com/+RajiniRao

In addition to writing science microblogs that aim to educate and engage the educated layperson, I moderate the largest science community on the Google Plus network, curate Science on Google+: A Public Database, STEM Women on Google+, and ScienceSunday. I am featured on Google's Suggested User List for Science and followed by >245K people.

RECOGNITION

AWARDS & FELLOWSHIPS

1980	Ranked 1st in the State of West Bengal, and 3rd in India, Indian School Certificate Examination
1983	Gold Medal in Chemistry, Gold Medal in Botany, Bangalore University, India Ranked 3rd in the Field of Science (Mathematics, Physics, Chemistry, Botany, and Zoology) by Bangalore University (>10,000 students)
1984-85	Program in Biology and Medicine Fellowship, University of Rochester, Rochester, NY
1987-88	Elon Huntington Hooker Graduate Fellowship in Chemistry, University of Rochester, Rochester
1989	Walter Bloor Award for Excellence in Biochemistry, University of Rochester, Rochester, NY
1988-89	James Hudson Brown/Alexander B. Coxe Postdoctoral Fellowship, Yale University, New Haven
1990-91	American Heart Association Postdoctoral Fellowship, Connecticut Affiliate
1994-97	American Cancer Society Junior Faculty Award, Johns Hopkins University, Baltimore
2001, 2003	Nico Van Uden Lecturer (key note speaker) at the 19th and 21st SMYTE conferences at Crete and Bonn
2006	Key note speaker, Pan American Plant Membrane Biology Workshop, South Padre Island TX
2009	**Teacher of the Year Award** from Graduate Student Association, Johns Hopkins University School of Medicine
2009	Johns Hopkins **Professors Award for Excellence in Teaching in Preclinical Sciences**
2009	Hans Prochaska Memorial Lecturer, Johns Hopkins MSTP-MD/PhD Program

INVITED TALKS & PANELS (selected representation)

1997	Uniformed Health Science Services, Bethesda, MD University of Maryland in Baltimore, MD
1998	Annual Meeting of the American Society for Microbiology, Atlanta, GA Symposium on Membrane Transport in Banff, Canada University of Virginia at Charlottesville
1999	Annual Meeting of the Biophysical Society, Baltimore, MD Small Meeting in Yeast Transport and Energetics, Spain University of Maryland at College Park, MD University of Alberta, Edmonton, Canada
2000	Annual Meeting of the Biophysical Society, Kansas City Small Meeting in Yeast Transport and Bioenergetics (SMYTE) in Brazil Public Health Research Institute of NY NIH Symposium on "Advances in Membrane Transport: Lessons from Model Organisms" in Bethesda
2001	Nico Van Uden/KEYNOTE Lecturer at the 19th SMYTE in Crete, Greece Wayne State University, Detroit MI Annual Meeting of the Biophysical Society, Boston, MA

Symposium on Model Organisms, American Physiological Society FASEB meeting in Orlando
Mid-Atlantic Yeast Meeting, Baltimore, MD
Gordon Research Conference on Mechanisms in Membrane Transport
FASEB conference on Transport ATPases, Snowmass, CO
Small Meeting in Yeast Transport and Bioenergetics (SMYTE) in Crete
Georgetown University, MD

2002 Annual Meeting of the Biophysical Society, San Francisco, CA
University of Chicago, IL
Syracuse University, NY
Small Meeting in Yeast Transport and Energetics, Baltimore, MD
Indian Institute of Science, Bangalore, India
University of Rochester, NY
Bowling Green State University of Ohio

2003 Annual Meeting of the Biophysical Society, San Antonio, TX
FASEB Conference on Transport ATPases, VT
Nico Van Uden/Keynote Lecturer of 21st SMYTE in Bonn, Germany

2004 Tufts University, Boston
University of Maryland Medical School, Baltimore
Annual Meeting of the Biophysical Society, Baltimore (Speaker for Transport and Permeability Subgroup)
University of Maryland at College Park, MD
Oregon Health Sciences University, Portland

2005 Annual Meeting of the Biophysical Society, Long Beach, CA
University of Maryland College Park
Mt. Sinai School of Medicine, NY
Georgia State University, Atlanta
Gordon Research Conference on Bioenergetics, NH
FASEB meeting on Transport ATPases, VT

2006 Annual Meeting of the Biophysical Society, Salt Lake City, UT
National Center for Biological Sciences, Bangalore, India
Pan American Workshop on Plant Membrane Proteins
Gordon Research Conference in Bioenergetics
SMYTE meeting on Transport and Energetics, Prague, CR

2007 Annual Meeting of the Biophysical Society, Baltimore, MD
Gordon Research Conference on Mechanisms of Membrane Transport, NH
International Conference on Plant Transport and Bioenergetics, Valencia, Spain
University of Nebraska, Lincoln, NE
Public Health Research Institute & UNDNJ, Newark, NJ
Emory University, Atlanta, GA

2008 Annual Meeting of the Biophysical Society, Long Beach, CA
FISEB/Ilanit meeting, Israel
Wayne State University, Detroit, MI
International meeting on P-type ATPases, Arhus, Denmark
SMYTE meeting on Transport and Energetics, Braga, Portugal
10^{th} Symposium of the European Calcium Society, Brussels, Belgium
ASBMB Special meeting on Cellular Lipid Transport, Alberta, Canada
Max Planck Institute for Biophysics, Frankfurt, Germany

2009	Annual Meeting of the Biophysical Society, Boston, MA Department of Biochemistry, SUNY Syracuse, NY Department of Biology, Kansas State Univ., Manhattan, KS
2010	Annual Meeting of the Biophysical Society, San Francisco, CA FASEB Transport ATPases, Snowmass, CO Gordon Research Conference on Membrane Transport, Biddeford, ME SMYTE, New Delhi, India EMBO conference on ER, Girona, Spain
2011	HHMI Med into Grad Conference, MD Conference on P-type ATPases, Asilomar, CA Catholic University, Washington DC
2012	Biophysical Society FASEB Summer Research Conference on Transport ATPases, Snowmass, CO Gordon Research Conference on Membrane Transporters, Les Diablerets, Switzerland University of Edmonton, Canada Calcium Signaling Symposium, Barcelona, Spain International Plant Biology Conference, Jeju, South Korea
2013	Gordon Research Conference on Salivary Glands and Endocrine Biology, Galveston,TX Biophysical Society, Philadelphia, PA University of Bern, Symposium on Excellence of Women in Science, Bern, Switzerland FASEB Summer Research Conference on Ion Channel Regulation, Nassau, Bahamas