

Raj Kumar, PhD

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Educational Qualification:

1. **Ph. D.** (Chemistry, Major-Biochemistry), 2012, University of Massachusetts, Lowell, MA, U.S.A. **Dissertation title:** Folding and Flexibility of Botulinum Neurotoxin Light Chain.
2. **M.S** (Chemistry, Major- Biochemistry), 2009, University of Massachusetts, Dartmouth, USA (2009).
3. **M.Sc.** (Chemistry, Major- Analytical Chemistry), 2001, Banaras Hindu University, Varanasi, India.
4. **B.Sc. (H)** (Physics, Chemistry, and Mathematics; Major- Chemistry), 1999, Banaras Hindu University, Varanasi, India.

Position Held:

1. **Institute of Advanced Sciences, Dartmouth (March 2014 – present):** Assistant Professor.
Responsibilities include Research and development in the area of protein chemistry, diagnostics, drug screening, drug delivery, cell culture, nanoparticles and biotechnology through conducting a variety of specialized laboratory procedures and researches. Specifically, isolation and purification of native and recombinant proteins, biochemical and biophysical characterization, structural analysis using UV/VIS spectrophotometry, fluorescence spectroscopy, circular dichroism, fluorescence microscopy, etc., development of antidotes against botulinum neurotoxins, extraction of bioactive compounds from plants, screening of synthetic and natural compounds against enzymatic activity of Botulinum neurotoxins, culture and testing of neuroblastoma cells and enteric neurons for testing neuroactive compounds, development of enzyme linked immunosorbent assay (ELISA) against pathogenic compounds, characterization and testing of vaccine candidates against tetanus and botulinum toxins; coordinate research

with collaborators at federal and corporation labs; organize and maintain research data and perform data analysis using lab information management system; writing grant proposals and submit to various agencies, including NIH and DOD; report to Director of Research and Development and CEO on issues related to project progresses and potential problems or difficulties in the projects. Member of IACUC (Institutional Animal Care and Use committee) and IBC (Institutional Biosafety Committee).

2. **Chemistry and Biochemistry Department, UMASS Dartmouth (January 2012 - December 2014):** As a part-time lecturer.
3. **Centre of Indic Studies, UMASS DARTMOUTH (February 2012 - May 2014):** Research Associate, responsible for writing grant proposals, experimentation, presentation, and assisting graduate and undergraduate students.
4. **Botulinum Research Center (January 2012 - August 2013):** Research Associate, responsible for writing grant proposals, experimentation, presentation, and assisting graduate and undergraduate students.
5. **Botulinum Research Center, UMASS DARTMOUTH (September 2007 - December 2011):** As a graduate student pursued my PhD work.
6. **Advinus Therapeutics, Pune, INDIA (A member of TATA group) (February 2006 - July 2007):** Worked as analytical scientist in drug discovery department. Responsible for purification of organic compound by mass based purification, qualitative/quantitative analysis and characterization of compounds.
7. **Regent Drugs Limited, INDIA (A member of TEVA group) (January 2004 - February 2006):** In charge of three different projects. Responsible for whole project; from literature search till validation of analytical methods and stability of final products. Also responsible for daily planning of team members. Presentation and communication of group works in different meetings.
8. **LUPIN Research Park, Pune, INDIA (June 2001 - January 2004):** Started as trainee in analytical research and development department. Responsible for routine analysis. After first year promoted as Assistant research Scientist (E-1), responsible for routine analysis, analytical method development, qualitative and quantitative analysis. Next year promoted as research scientist (E-II), responsible for routine analysis, analytical method development, validation and stability. Responsible for planning of my team and project report preparation and communication to other concerned department. Also responsible for transferring the analytical methods to QC and successfully performed various pilot projects.

Scholarships, Awards and Positions:

1. Best participant award in Chemistry Quiz held at Mrs. K.M.P.M School, Jamshedpur, India, 1995.
2. Successfully completed summer internship at Tata Steel, Jamshedpur, India, 2000.
3. Second Prize in Quiz held at Advinus Therapeutics (A Member of TATA group), 2006.
4. Graduate Assistant, Botulinum Research Center, UMASS, Dartmouth, September - December 2007.
5. Shaukat Ali Memorial Scholarship, 2008, UMASS, Dartmouth.
6. Research Assistant, Botulinum Research Centre, UMASS, Dartmouth, January 2008 - December 2009, August - December 2010.
7. Teaching Assistant, Chemistry and Biochemistry Department, UMASS, Dartmouth, January- May 2010.
8. Teaching Assistant, Chemistry and Biochemistry Department, UMASS, Dartmouth from Jan. 2011 to May 2011.
9. Teaching Fellow at Chemistry and Biochemistry Department, UMASS, Dartmouth from Sept. 2011 to Dec. 2011.
10. Awarded Dissertation Writing Support Grant from UMASS, Dartmouth 2011.

Invited Seminar/Symposium Speaker:

1. Advinus Therapeutics, Pune, India, 7th March, 2007. **Topic:** CETP (Cholesterol Ester Transferase Protein) as potential target for lowering LDL level.
2. WAVES conference, University of Massachusetts, Dartmouth, 13-15th July, 2012. **Topic:** Neurological Link between Diet and Mind.
3. Botulinum Research Symposium, University of Massachusetts, Dartmouth, 16-17th August, 2012. **Topic:** Comparative functional folding of BoNT endopeptidase.
4. Youth Camp, University of Massachusetts, Dartmouth, 31st July, 2013. **Topic:** Chemistry: Our Life Our Future.

5. Botulinum Research Symposium, UMASS Dartmouth, 14-16th August, 2013. **Topic:** Differential Role of Molten Globule and Protein Folding in Distinguishing Unique Features of Botulinum Neurotoxin Endopeptidase.
6. Department of Chemistry and Biochemistry, UMASS Lowell, 7th November, 2013. **Topic:** Uniqueness of Botulinum Toxin.

Teaching Experience:

1. Teaching Assistant at Chemistry and Biochemistry Department, University of Massachusetts, Dartmouth from January 2010 to May 2010 (Freshman chemistry lab).
2. Teaching Assistant at Chemistry and Biochemistry Department, University of Massachusetts, Dartmouth from January 2011 to May 2011 (Biochemistry lab).
3. Teaching Fellow at Chemistry and Biochemistry Department, University of Massachusetts, Dartmouth from September 2011 to December 2011 (Freshman chemistry instructor for chemistry majors/non-majors).
4. Part-time Lecturer at Chemistry and Biochemistry Department, UMASS, Dartmouth from January 2012 – December 2013 (Freshman chemistry lecture/labs for chemistry majors/non-majors, supervised chemistry lab for seniors).
5. Taught chemistry theory/lab to the students of American Vivekanand Academy, New Hampshire, Fall 2012.

Undergraduate Teaching:

CHM 151, General Chemistry I (3 semesters)
CHM 152, General Chemistry II (3 semesters)
CHM 161, General Chemistry Laboratory I (3 semesters)
CHM 162, Chemistry Laboratory II (1 semester)
CHM 163, Chemistry Laboratory I (For Chemistry Major, 1 semester)
CHM 414, Biochemistry Laboratory (1 semester as Teaching Assistant)

Graduate Teaching:

CHM 529, Physical Biochemistry (one three hour class about Protein Folding).

Student Advisement:

Graduate Students: 1) Tom Feltrup
2) Harkiran Preet Dhaliwal
3) Gowri Chellapan
4) Pavithra Janardhanan

Undergraduate Students: 1) Sara Sabet

High School Students: 1) Brooke Spencer (Dartmouth High School, MA)
2) Lindsey Foster (Dartmouth High School, MA)
3) Fardeen Rashid (Dartmouth High School, MA)
4) Zachary Young (Bishop Connely High School, MA)

Research Interest:

Bio-Molecular spectroscopy, Protein folding and dynamics, Cellular biology, Molecular Dynamics Simulation, Protein NMR and Neuroscience.

Publications:

1. **Kumar, R.**, Zhou, Y., Ghosal, K., Cai, S., and Singh, B. R. (2012) Anti-apoptotic activity of hemagglutinin-33 and botulinum neurotoxin and its implication to therapeutic and countermeasure issues. *Biochemical and Biophysical Research Communication*, 417, 726-731.
2. Singh, B. R., and **Kumar, R.** (2012) Modern scientific view of Ayurveda. *Light on Ayurveda Journal*, XI, 16-22.
3. Singh, B. R., Kumar, R., and Cai, S. (2013) Molecular mechanism and effects of Clostridial neurotoxins. In *Handbook of Neurotoxicity* (Editor: Kostrzewa, Richard M, Springer), Springer Publication, New York, 513 - 551.
4. **Kumar, R.**, Kukreja, R. V., Li, L., Zhmurov, A., Kononova, O., Cai, S., Ahmed, S. A., Barsegov, V., and Singh, B. R. (2013) Botulinum neurotoxin: unique folding of enzyme domain of the most-poisonous poison. *Journal of Biomolecular Structure and Dynamics*, 32, 804-815.
5. **Kumar, R.**, Chang, T. W., and Singh, B. R. (2013) Evolutionary traits of toxins. *Handbook of Toxinology* (Editor: P. Gopalakrishnakone, Springer): *Biological Toxins and Bioterrorism*, Springer Dordrecht Heidelberg New York London, Vol 1, chapter 23, 527 - 557.

6. **Kumar, R.**, Kukreja, R., Cai, S. and Singh, B. R. (2014) Differential Role of Molten Globule and Protein Folding in Distinguishing Unique Features of Botulinum Neurotoxin. *Biochimica et Biophysica Acta – Proteins and Proteomics*, 1844, 1145-1152.
7. Chellappan, G., **Kumar, R.**, Cai, S., and Singh. B. R. (2014) Role of neurotoxin associated proteins in the Low pH induced structural changes in the botulinum neurotoxin complex. *The Protein Journal*, 33, 557 - 564.
8. **Kumar, R.**, Cai, S., and Singh, B. R. (2015) Resolution of sub-nano second motion in BoNT/A LC: An evidence of internal flexibility. *Biochimica et Biophysica Acta – Proteins and Proteomics*, 1854, 321- 326.
9. Chellapan, G., **Kumar, R.**, Goyal, D., Cai S., and Singh, B. R. (2015) Structural and functional analysis of botulinum neurotoxin subunits for pH-dependent membrane channel formation and translocation. *Biochemical et Biophysica Acta — Proteins and Proteomics*, 1854, 1510 - 1516.
10. **Raj Kumar**, Harkiran Preet Kaur Dhaliwal, Roshan Vijay Kukreja, Bal Ram Singh (2016). Botulinum toxins: molecular structure and mechanisms of action in motor and sensory systems. *Seminars of Neurology* (accepted).

Manuscripts:

1. **Kumar, R.**, Burke, J., Cai, S., and Singh, B. R. SAXS analysis of conformational state of BoNT/A LC (*Manuscript in preparation*).
2. **Kumar, R.**, and Singh, B. R. Botulinum Toxin and Pain. (Manuscript in preparation).

Book and Book Chapters in process of submission:

1. Bal Ram Singh, **Raj Kumar**, Brian Blanchette. Handbook of Biochemistry Lab: An Integrated Biochem Lab, Submitting to Cambridge Publication, India.
2. Accepted invitation and contract for submitting a book on title, **Toxins: A model for protein chemistry** from Springer Brief, New York, USA.

Poster Presentations:

1. **Raj Kumar**, Shuwei Cai, and Bal Ram Singh (2008) Protein flexibility through hydrogen exchange, 14th Annual Sigma Xi Research Exhibit, University of Massachusetts Dartmouth, North Dartmouth, MA, April 29-30, 2008.

2. **Raj Kumar**, Yu Zhou, Koyel Ghosal, Shuowei Cai, Bal Ram Singh (2008) Anti-apoptotic property of Hn-33. Second Annual Botulinum Research Symposium, UMASS Dartmouth, August 20-21, 2008.
3. **Raj Kumar**, Li Li, Roshan Kukreja, Shuowei Cai, Bal Ram Singh (2009) A biologically active intermediate of urea denaturation in botulinum neurotoxin endopeptidase. Inter Botulinum Research Coordination Committee Conference (2009) in Alexandria, VA; 15th Annual Sigma Xi Research Exhibit, University of Massachusetts Dartmouth, North Dartmouth, MA, April 28-29, 2009, and Third Annual Botulinum Research Symposium, UMASS Dartmouth, August 20-21, 2009.
4. **Raj Kumar**, Silvi Agarwal, Artem Zhumarov, Valerie Bargesov, Bal Ram Singh (2010). MD simulation of BoNT/A LC. 16th Annual Sigma Xi Research Exhibit, University of Massachusetts Dartmouth, North Dartmouth, MA, April 28-29, 2010 and in Fourth Annual Botulinum Research Symposium, August 19-20, 2010..
5. **Raj Kumar**, R. Kukreja, Li Li, Shuowei Cai, Syed A. Ahmed, and Bal Ram Singh (2011) A unique urea denaturation pattern of botulinum neurotoxin A endopeptidase. 17th Annual Sigma Xi Research Exhibit, University of Massachusetts Dartmouth, North Dartmouth, MA, April, 2011, and in Fifth Annual Botulinum Research Symposium, August 18-19, 2011.
6. **Raj Kumar**, Emmanuel Ojadi, Shuowei Cai and Bal Ram Singh (2011) Resolution of sub-nanosecond motion of BoNT/A endopeptidase: An evidence of internal flexibility. Fifth Annual Botulinum Research Symposium, August 18-19, 2011, and Eight Annual Botulinum Research Symposium, August 13-15, 2014
7. **Raj Kumar**, Mario J. Oliveira, Shuowei Cai, and Bal Ram Singh (2012) Dynamics of BoNT/A endopeptidase during catalysis. 18th Annual Sigma Xi Research Exhibit, University of Massachusetts Dartmouth, North Dartmouth, MA, April 30, 2012.
8. **Raj Kumar**, Jordan Burke, Marco Tonelli, Milo Westler, Shuowei Cai, and Bal Ram Singh (2013) SAXS and NMR analyses of active conformational states of BoNT/A endopeptidase. 19th Annual Sigma Xi Research Exhibit, University of Massachusetts Dartmouth, North Dartmouth, MA, April 23-24, 2013, Sigma XI, and Sixth Annual Botulinum Research Symposium, August 15-16, 2011.
9. **Raj Kumar**, Shuowei Cai, and Bal Ram Singh (2013) Effect of Digested peptides from dietary proteins on regulation of natural health. 19th Annual Sigma Xi Research Exhibit, University of Massachusetts Dartmouth, North Dartmouth, MA, April 23-24, 2013.
10. Thomas Feltrup, **Raj Kumar**, Shuowei Cai, and Bal Ram Singh (2013) Differential activity of BoNT/A and BoNT/E with respect to substrate length demonstrates the

involvement of exosite binding in endopeptidase activity. 19th Annual Sigma Xi Research Exhibit, University of Massachusetts Dartmouth, North Dartmouth, MA, April 23-24, 2013, and in Seventh Annual Botulinum Research Symposium, August 15-16, 2013.

11. Gowri Chellappan, **Raj Kumar**, Shuowei Cai, and Bal Ram Singh (2013) Role of neurotoxin Associated Proteins in the Low pH Induced Structural Changes in the Botulinum Neurotoxin Complex. 19th Annual Sigma Xi Research Exhibit, University of Massachusetts Dartmouth, North Dartmouth, MA, April 23-24, 2013; Seventh Annual Botulinum Research Symposium, August 15-16, 2013.
12. Harkiranpreet Dhaliwal, Nagarajan Thirunavukkarasu, **Raj Kumar**, Paul K. Kinker, Easwaran Ravichandran, Alan Fikelstein, Shuowei Cai and Bal Ram Singh (2013) Identification of ion-channel forming structural determinants in botulinum neurotoxins. 19th Annual Sigma Xi Research Exhibit, University of Massachusetts Dartmouth, North Dartmouth, MA, April 23-24, 2013; Seventh Annual Botulinum Research Symposium, August 15-16, 2013, and in Inter Botulinum Research Coordination Committee, Maryland, October 21-25, 2013.
13. **Raj Kumar**, Jordon Burke, and Bal Ram Singh (2014) Active Conformational States of Botulinum Endopeptidase as Determined by SAXS. Eight Annual Botulinum Research Symposium, August 13-15, 2014.
14. Brook Spencer, Lindsey Foster, Sara Sabet, **Raj Kumar**, Kodumudi Venkat Venkateshwaran, Shuowei Cai, and Bal Ram Singh (2014) A Combination of Isoelectric and Ammonium Sulfate Precipitation Enhances Detection of BoNT/A in a Monoclonal Antibody based Sandwich ELISA. Eight Annual Botulinum Research Symposium, August 13-15, 2014. Ninth Annual Botulinum Research Symposium, August 12-14, 2015.
15. **Raj Kumar**, Olga Kononova, Shuowei Cai, Valeri Barsegov, and Bal Ram Singh (2014) Dynamic Solution Structure of BoNT/A Light Chain Critical for Binding to Potential Inhibitors. Inter Botulinum Research Coordination Committee Conference in Philadelphia, October 26-29, 2014.
16. **Raj Kumar**, and Bal Ram Singh (2015). Virtual Screening of small molecule inhibitor against BoNT/A LC. Ninth Annual Botulinum Research Symposium, August 12-14, 2014.
17. **Raj Kumar**, Kruti Patel, Shuowei Cai and Bal Ram Singh (2015). Virtual Screening and ADMET analysis of endopeptidase inhibitors. Inter Botulinum Research Coordination Committee Conference in Philadelphia, October 25-28, 2015.
18. **Raj Kumar**, Wei Ping Yang, Thomas Feltrup, Guncha Ambrin, Tzuu Wang Chang, Paul Lindo, Shuowei Cai, and Bal Ram Singh (2015). Inter Botulinum Research Coordination

Committee Conference in Philadelphia, October 25-28, 2015.

19. Bal Ram Singh, Sirisha Mukkavalli, and **Raj Kumar** (2015). Vedantic Foundations of Ayurvedic Science and Technology. Vedanta Conference at Jawaharlal Nehru University, India, December 27 - 30, 2015.

Memberships:

1. American Academy of Advancement of Science Member (2009 - present).
2. American Chemical Society Member (2010-2012)
3. American Federation of Teachers (2012 - 2014)
4. Society for Science and Public (2014 - present)
5. American Society for Pharmacology and Experimental Therapeutics (ASPET) (2015 - present)