



### ***CURRICULUM VITAE***

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#### **EDUCATION\***

- 1976-1980 Ph. D.; Title: “Experimental Studies on Some Chemotherapeutic and Immunological Aspects of Primate Malaria (*Plasmodium knowlesi* infection)” work done at Central Drug Research Institute, Lucknow.
- 1975-1976 Proficiency in French; University of Lucknow, Lucknow.
- 1973-1975 M. Sc.; Zoology (Physiology/Entomology); University of Lucknow. (*I division and II position in order of merit in the university*).
- 1971-1973 B. Sc.; Chemistry, Botany, Zoology and Gen. English; University of Lucknow, Lucknow.
- 1988 Indo-US Workshop on Cell Mediated Immunity in Relation to Tropical Diseases, Lucknow.
- 1989 IUIS -WHO-AIIMS Advanced Immunology Course, New Delhi.
- 1991 Indo-US Workshop on Current Approaches for Receptor Studies in Neurobiology, Lucknow.
- 1992 Course on Management of Research Programmes, Council of Scientific and Industrial Research, New Delhi.
- 2003 Induction Training Programme for Faculty of NIPER, by Education and Educational Management Department, National Institute of Technical Teacher’s Education and Research, Chandigarh.

\* Process for the submission of **D. Sc.** degree thesis titled “*Studies on some Parasitic Protozoans of National Health and Pharmaceutical Importance*” to C. S. J. M. University, Kanpur has been started. Thesis synopsis submitted on Jan. 06, 2006.

### **PROFESSIONAL POSITIONS** (in reverse chronological order) \*

- 2004–present **Professor**, Pharmacology and Toxicology, and **In-charge**, Centre for Infectious Diseases, National Institute of Pharmaceutical Education and Research, S.A.S. Nagar.
- 1997–2004 Associate Professor, National Institute of Pharmaceutical Education and Research, S.A.S. Nagar.
- 1991–1996 Scientist-C (Group Leader), Division of Microbiology, Central Drug Research Institute, Lucknow.
- 1988–1991 Scientist-B, Division of Microbiology, Central Drug Research Institute, Lucknow.
- 1987–1988 Scientist (Pool Officer), Division of Microbiology, Central Drug Research Institute, Lucknow.
- 1986 Research Associate, Department of FCPM, Stanford University Medical Center, Stanford, CA, USA.
- 1984–1985 Research Associate, Department of Microbiology, The Ohio State University, Columbus, OH, USA.
- 1983–1984 Scientist-in-charge, Department of Protozoology, Hindustan Ciba-Giegy Research Centre, Mumbai.
- 1979–1982 Senior Scientific Asstt., Research Centre, Indian Drugs and Pharmaceuticals Ltd., Hyderabad.
- 1976–1979 Junior Research Fellow, Division of Microbiology, Central Drug Research Institute, Lucknow.

### **PERSONAL DETAILS**

Date of birth, July 05, 1954; Age, 56 years; height, 5 feet 5 ½ inches; weight, 66 kg; health, excellent; married; one daughter 23 years; religion, Hindu; hobby–intelligent discussions, long morning walks, chess, photography, music.

### **MEMBERSHIPS OF PROFESSIONAL SOCIETIES/ORGANIZATIONS**

1. Regular Member, Society on NeuroImmune Pharmacology, USA.
2. Life Member, The National Academy of Sciences, India, Allahabad.
3. Life Member, Inflammation Research Association, U.S.A.
4. Member, International Brain Research Organization, France.
5. Life Member, Indian Immunology Society.
6. Life Member, Indian Academy of Neurosciences.
7. Life Member, Indian Science Congress Association.
8. Life Member, Indian Society for Parasitology.
9. Life Member, U. P. Association for the Advancement of Science.
10. Life Member, Association of Microbiologists of India.
11. Life Member, Indian Pharmacology Society.

12. Founder Member, Molecular Immunology Forum.
13. Ex. Vice-President, Indian Society of Chemists and Biologists.

## AWARDS/HONOURS

- **Elected**, At-Large Councilor (non-US) 2010, Society on Neuroimmune Pharmacology, USA.
- *Nominated* for Election to Fellow of the Indian Academy of Neurosciences 2009.
- Awarded financial support to participate in the 15<sup>th</sup> Society on Neuroimmune Pharmacology conference, April 21-24, 2009, Wuhan, China.
- **Elected, Fellow** of the **Association of Microbiologists of India** (2008).
- **The Bill and Melinda Gates Foundation Global Health Travel Award 2008** to attend the Keystone Symposia E3 Malaria: Immunology, Pathogenesis and Vaccine Perspectives, Alpbach Congress Centrum, Alpbach, Austria, Austria, June 08-13, 2008.
- **Selected** as **IBCs Leading Scientist of World 2008**.
- Bioorganic & Medicinal Chemistry **Most Cited Paper 2003–2006 Award**. Bioorganic and Med. Chem. 2004 **12**: 2501-2508.
- **Member, Editorial Board**, *Journal of Neuroimmune Pharmacology*, USA.
- **Editor/Reviewer**, *Science Alert*.
- National Institute on Drug Abuse, USA, **Travel Grant Awardee** (2006) for participation in 12<sup>th</sup> Society on NeuroImmune Pharmacology Conference, Santa Fe, New Mexico, USA.
- **Editor-in-Chief**, *Journal of Parasitic Diseases* (2006-2008).
- Member, Executive Committee, Indian Society for Parasitology.
- **Member, Editorial Advisory Board**, “Recent Patent Reviews on Anti-Infective Drug Discovery”, Bentham Science, USA.
- **Elected, Fellow** of The National Academy of Sciences of India, Allahabad (2004) for his contribution in the field of biotechnology, parasitology and *neuroimmunomodulation*.
- **Awarded**, Indian Science Congress Association best presentation award in Section: New Biology (including biochemistry, biophysics and molecular biology & biotechnology), 2003.
- **Selected** for biographical inclusion in the Ninth Edition of *International Directory of Distinguished Leadership*, 2000.
- **Awarded**, prestigious *Tulsabai Somani Educational Trust* 1992 award of the Indian Academy of Neurosciences.

## RECOGNITIONS

- Special Invitee, SAC, DMRC, Jodhpur and Chairman, Scientific Working Group, DMRC, Jodhpur (2010).
- Expert, Doctoral Committee, Ph. D. student, SRM University, Kattankulathur, Tamil Nadu (2009).
- Expert, Research Grant Proposal Evaluation, Council of Scientific and Industrial Research, New Delhi (2009).

- Expert, Selection Committee, Pharmaceutical Sciences and Drug Research, Punjabi University, Patiala (2008).
- Chairman, Selection Committee, Scientist B, National Institute of Occupational Health (ICMR), Ahmedabad (2008).
- Organizing Secretary, “International Conference on Biotechnological Approaches to Neuroimmunomodulation and Infectious Diseases”, Dec.11-13, 2008, NIPER, S. A. S. Nagar.
- Expert, Research Grant Proposal Evaluation, Department of Biotechnology, New Delhi (2008).
- Invitee, The Third Open Forum on Key Issues in Tuberculosis Drug Development, organized by TB Alliance, The Bill and Melinda Gates Foundation, The Stop TB Partnership Working Group and Treatment Action Group, New Delhi (May 5-6, 2008).
- Member, Selection Committee, Scientist C, National Institute of Occupational Health (ICMR), Ahmedabad (2008).
- Member, Scientific Advisory Committee, Desert Medicine Research Centre, (ICMR), Jodhpur (2008).
- Member (Special Invitee), Scientific Advisory Committee, National Institute of Occupational Health (ICMR), Ahmadabad (2008).
- Nodal Officer, National Institute of Pharmaceutical Education and Research, to be set up at Rai Bareli, Ministry of Chemicals and Fertilizers, Govt. of India.
- Expert, Technology Information, Forecasting and Assessment Council (TIFAC), New Delhi (2007).
- Evaluator, Research Grant Proposal, Department of Science and Technology, New Delhi (2006).
- Expert Attendee, Expert Focus Group: MMV–Shin Poong Pyronaridine-Artesunate Project Development Team, September 15, 2005, La Salle Notre Dame de la Grade, Marseille, France.
- Research Grant Proposal Evaluator, Council of Science and Technology, U.P., Lucknow (2005).
- Referee, Mini-Reviews in Medicinal Chemistry.
- Referee, Proc. of the Nat. Acad. of Sciences, India (Sec. B–Biol. Sciences)
- Referee, National Academy Science Letters.
- Chairman, Scientific Session: Toxicological Problems in Occupational Health, International Conference on Health, Occupation and Environment, Nov. 1–3, 2004, Industrial Toxicology Research Center, Lucknow.
- Member, Senate, National Institute of Pharmaceutical Education and Research, S. A. S. Nagar (2000–2004).
- Faculty member, Refresher Course in Zoology, Academic Staff College, Shimla University, Shimla, 2004.
- Coordinator, NIPER Thrust Areas of Research: MALARIA and TUBERCULOSIS.
- Faculty member, Refresher Course in Zoology, Academic Staff College, Panjab University, Chandigarh, 2000.
- Organizing Secretary, The Millennium Symposium *Malaria 2000*, NIPER, S. A. S. Nagar, 2000.

- Organizing Secretary, Indo-US Symposium on Recombinant DNA Technology and its Application in Drug Discovery, NIPER, S. A. S. Nagar, 1999.
- Joint-Organizing Secretary, National Conference on Chemistry and Biology of Herbal Medicine, Lucknow, 1997.
- Treasurer, CSIR-SWA Silver Jubilee Symposium on Intellectual Property Rights and Industrial Development in India–Health, Agriculture and Environment, Lucknow, 1996.
- Member, Scientific and Publications Committee, First Annual Conference on Chemistry, Biology Biology and Health-Care, Lucknow, 1996.
- Faculty member, NAM and Third World Academy Workshop on Antimalarial Evaluation and Biocide Assay for Control of Malaria, Lucknow, 1994.
- Faculty member, Refresher Course, Academic Staff College, University of Lucknow, Lucknow, 1993.
- Faculty Member, UNESCO-CDRI Workshop on the Use of Pharmacological Techniques for the Study of Natural Products, Lucknow, 1992.
- Member, R and D Highlights and Publications and, Finance Committees, CSIR Golden Jubilee Symposium on Tropical Diseases: Molecular Biology and Control Strategies, Lucknow, 1992.
- Member, Organizing Committee, CSIR Exposition on Medicinal Plants, CDRI, Lucknow, 1989.
- Secretary, Scientific and Publications Committee, Symposium on Recent Advances in Protozoan Diseases, Hind. Ciba-Geigy Ltd., Bombay, 1983.
- Referee, Indian Journal of Medical Research, 1983-84.
- Vice-President, Zoological Society, University of Lucknow, Lucknow, 1975.

### BOOKS EDITED

- Co-editor, **Prati Pal Singh** and R M Donahoe (Eds.). 2009. *“Proceedings of International Conference on Biotechnological Approaches to Neuroimmunomodulation and Infectious Diseases”*. pp i-xii + 508, ISBN 978-81-8465-013-6.
- Co-editor, **Prof. Prati Pal Singh** and Prof. V. P. Sharma, (Eds.). 2009. Proceedings of the National Academy of Sciences, India. Section B – Biological Sciences. Special Issue titled *“Human Parasitic Infections of Pharmaceutical and National Health Importance”*. pp 220, ISSN 0369-8211 (released Dec. 2009)

### VISITS ABROAD

- October 25-30, 2010: Institute of Medical Microbiology, Justus Liebig University, Giessen, **Germany**.
- October 17-19, 2010: Annual General Assembly Meeting of the Indo-EU project (FP7) titled “New approaches to target tuberculosis”, London, **UK**.
- September 30, 2009: TSE System GmbH, Siemensstr., Bad Homburg, **Germany**. (*Invited Lecture*)

- September 29, 2009: Klinik für Anaesthesiologie und operative Intensivmedizin, Freie Universität Berlin, Charité-Campus Benjamin Franklin, 12200 Berlin, **Germany**. (*Invited Lecture*)
- September 27-29, 2009: Annual General Assembly meeting of the Indo-EU project (FP7) titled “New approaches to target tuberculosis”, **Germany**.
- September 25-27, 2009: Institute of Medical Microbiology, the Justus-Liebig University, Giessen, **Germany**. (*Invited Lecture and discussions for initiating collaborative research projects funded by some international funding agency*)
- April 21-25, 2009: 15<sup>th</sup> Annual Conference of Society on Neuroimmune Pharmacology, Wuhan, **China**. (*Invited Lecture*)
- November 14-15, 2008: Institute of Medical Microbiology, Otto-van-Guericke University Magdeburg, **Germany**. (*Invited Lecture*)
- November 10-13, 2008: Start-up meeting of the recently funded FP7 Indo-EU project titled “New approaches to target tuberculosis”, Leuven, **Belgium**.
- June 15-17, 2008: Institute of Medical Microbiology, Otto-van-Guericke University Magdeburg, **Germany**. (*Invited Lecture*)
- June 12-15, 2008: Department of Public Health-Microbiology-Virology, University of Milan, **Italy**. (*Invited Seminar*)
- June 07-12, 2008: Keystone Symposia Conference, E3 “Malaria: Immunology, Pathogenesis and Vaccine Perspectives”, Alpabach Congress Centrum, Alpabach, Austria, **Austria**.
- April 04-10, 2006: 12<sup>th</sup> Society on NeuroImmune Pharmacology Conference, Santa Fe, New Mexico, **USA**.
- Sept. 16, 2005: Departement de Medecine Moleculaire, Institut Pasteur, Paris, **France**. (*Invited Lecture*)
- Sept. 15, 2005: Genetique Experimentale et Moleculaire Institut de Transgenose, Orleans, **France**. (*Invited Lecture*)
- Sept. 11-14, 2005: World Congress on “Medicine and Health in the Tropics”, Marseille, **France**.
- Sept. 29-Oct. 02, 1999: The 4<sup>th</sup> International Congress of the International Society for Neuroimmunomodulation, Lugano, **Switzerland**.
- Jan.–Aug. 1986: FCPM department, Stanford University, Stanford, CA, **USA**.
- May, 1985: Division of Clinical Immunology and Allergy, Montreal General Hospital, Montreal, **Canada**.
- Jul. 1984–Dec. 1985: Microbiology Department, The Ohio State University, Columbus, OH, **USA**.

## **RESEARCH EXPERIENCE** (*Thirty three years*)

**Broad area of specialization:** *Pharmaceutical Education and Research*

**Specific areas of specialization:** *Parasitic and microbial infections:* chemotherapy, immunology, bioimmunotherapy and pathogenesis (mainly of tuberculosis, malaria, leishmaniasis and amoebiasis); *biotechnology, inflammation, drug- and immune-toxicology, neuroimmunomodulation.*

**Brief summary of research work:**

1. Cultivation of *Plasmodium falciparum*, *in vitro*, and the antimalarial activity evaluation of potential compounds against *P. falciparum* using <sup>3</sup>H-hypoxanthine incorporation, *in vitro*. Eleven new compounds have been identified for further evaluation in models of simian malaras.
2. Large scale screening of potential antimalarial compounds for blood-schizontocidal activity against rodent malaras (*P. yoelii nigeriensis* and *P. berghei* infection in mice). Screening of potential antimalarial compounds for tissue-schizontocidal activity by using sporozoite-induced *P. yoelii nigeriensis* infection in mice. An insectary has been established for this purpose.
3. Antituberculosis activity evaluation of potential compounds against *Mycobacterium tuberculosis* H37Ra and H37Rv, and *M. smigmatis*, *in vitro* (both by using BACTEC 460 and by using macrophage cultures), and *in vivo* (mouse model).
4. A new rodent model (*P. yoelii nigeriensis*/mouse) has been developed to evaluate potential immunoadjuvants for malaria vaccines; IL-1 peptide 163-171 has been observed to show strong co-adjuvant activity with saponin in this model.
5. Production and characterization of monoclonal antibodies (MAbs) that block *P. yoelii nigeriensis* merozoite invasion into erythrocytes, *in vitro*, and passive transfer of protection *in vivo*. These studies led to the discovery of the phenomenon of functional dichotomy of the protective MAbs.
6. We have, *for the first time*, demonstrated that recombinant mouse granulocyte-colony stimulating factor and methionine-enkephalin (M-ENK)/its fragment peptide Tyr-Tyr-Gly co-administration can protect mice against both sporozoite- and trophozoite-induced rodent malaria, *in vivo*, apparently via macrophage-mediated mechanisms which are, at least partly, nitric oxide-dependent.
7. Morphine, in a dose-dependent manner, protected hamsters against *Leishmania donovani* infection via macrophage-mediated nitric oxide-dependent mechanisms.
8. *L. donovani* total soluble antigens and a purified 12 kDa antigen-induced colony-stimulating factors (CSFs) production by macrophages *in vitro*, which was modulated by dose-dependent quantities of enkephalins and morphine in a pertussis toxin-sensitive manner.
9. Purified mouse serum amyloid P-component (SAP) induced the production of CSFs, both *in vitro* and *in vivo*.
10. One antigenic variant of *P. knowlesi* showed reduced susceptibility to chloroquine compared to parent strain, *in vitro* and *in vivo*. Antigenic variants of *P. falciparum* have also shown differences in their chloroquine susceptibilities, *in vitro*.

11. Recombinant human interleukin-12 (IL-12) sterile-protected monkeys from *P. cynomolgi* B sporozoite-induced malaria.

12. Effect of known antimalarials on plasmodial antigens-induced elaboration of CSFs by macrophages was studied *in vitro*. Since CSFs are important immunoregulatory molecules, they can function as molecular markers of immunomodulation. Chloroquine inhibited whereas arteether ( $\alpha/\beta$ ) augmented CSF elaboration.

13. *Ours is the first ever report* that morphine, an opiate, can protect against malaria. Morphine in a dose-dependent manner, biphasically modulated the course of *Plasmodium berghei* infection in mice; sometimes even completely protected the animals by eliminating the parasitaemia. Morphine modulated the elaboration of CSFs by malarial antigens-stimulated macrophages *in vitro*, resulting in the alteration of the pool-size and phagocytic potential of the macrophages. This plausibly is one mechanism by which morphine modulated the course of malaria infection in mice.

14. M-ENK and its analogue C.D.R.I. compound 82/205, in a concentration-dependent biphasic manner, modulated the elaboration of CSFs by malarial antigens-stimulated macrophages, and of lymphokines (IFN- $\gamma$  and IL-4) by Con A-stimulated splenocytes.

15. Morphine, M-ENK, dermorphin and, compounds 82/205 and 90/651 showed significant immunoadjuvant activity in a new rodent malaria (*P. yoelii nigeriensis*/mouse) vaccination model.

16. Purified human CRP induced increase in serum CSFs in monkeys (*Macaca mulatta*) and stimulated monkey macrophages to elaborate CSFs, *in vitro*. The *in vitro* production of CSFs was IL-1- and LPS-independent, and *de novo*.

17. Monkeys having purified human CRP administered i/v and, monkeys having turpentine (TT) oil-induced inflammation sterile protected themselves against infective *P. cynomolgi* sporozoite challenge. Serum from these TT oil-treated monkeys strongly cross-reacted with rabbit anti-human CRP polyclonal antibody.

18. Purified human CRP activated monkey macrophages for enhanced phagocytosis of *P. fragile*-infected monkey erythrocytes.

19. Poly IC:LC induced increased production of serum CSFs in mice; *in vitro* stimulated the mouse peritoneal macrophages to elaborate CSFs. The elaboration of CSFs was IL-1- and LPS-independent, and *de novo*.

20. Human interleukin-1 $\beta$  peptide 163-171 and other related synthetic peptides induced the production of CSFs by macrophages. Splenopentin-5 and other related peptides induced varying degrees of maturation of monkey immature T-cells. Human  $\beta$ -casein fragment 54-59 peptide and its analogue exerted biphasic immunomodulatory effects on macrophage erythrophagocytosis.

21. During sporozoites- and trophozoites-induced *P. cynomolgi*-infection in monkeys, increased production of serum CSFs occurred. *In vitro* both intact *P. cynomolgi*-infected monkey erythrocytes and their soluble components stimulated monkey macrophages to *de novo* produce CSFs in an LPS-independent manner. Similar results were obtained using *P. berghei* and mice. Lymphokines IFN- $\gamma$  and IL-4 were elaborated by recall-antigens-stimulated splenocytes from monkeys previously infected with *P. cynomolgi* and *P. knowlesi*.

22. Immune-complexes (ICs) containing *P. knowlesi* and *P. berghei* antigens mediated the evasion of plasmodia from destruction by macrophages, ICs stimulated macrophages to produce CSFs, *in vitro*.

23. Studied the basic immune mechanisms determining host specificity between snails and schistosomes using MAbs and autoradiographic techniques.

24. Studied the induction kinetics of SAP, a mouse acute-phase reactant, in various inbred and recombinant inbred Lr and Ls mouse strains during *Listeria monocytogenes* infection; correlation between SAP levels and genetic control of host resistance; purification (by affinity chromatography) and detailed characterization of SAP; role of SAP in *in vitro* macrophage (peritoneal, BM-derived and sub-cutaneous) activation; its role in non-specific host defense mechanisms; various other immunoregulatory properties of SAP.

25. Developed a new model (*Entamoeba muris*/rat) for the evaluation of luminal amoebicides. Also worked on the MAb production, purification and characterization; use of MAb in antigen identification and development of diagnostic kits for amoebiasis and giardiasis.

26. I was group leader of the team involved in the pre-clinical anti-amoebic activity evaluation of new drug satranidazole (CG-10213 GO) against *E. histolytica*, both *in vivo* and *in vitro* (axenic culture).

27. Experimental studies on chemotherapy and immunology (cellular and humoral) in *P. knowlesi*/rhesus monkey (*Macaca mulatta*) model; development, isolation, characterization and chemotherapy of new antigenic variants of *P. knowlesi*; evaluation of synthetic compounds, mefloquine and various antibiotics in *P. knowlesi*-infected monkeys; immunodiagnostic tests; *in vitro* and *in vivo* correlates of protective immunity to *P. knowlesi* and identification of new hosts for *P. knowlesi*. (Ph.D. degree was awarded on this work by Kanpur University).

**TEACHING EXPERIENCE:** (Fourteen years; 1997 onwards)

### Special attainments in education

For last nearly 14 years, I am involved in the teaching of biotechnology, microbiology, parasitology, neuroimmunology and new drug research to Pharmaceutical Sciences students. For this, special courses addressing to our National

and International Health problems (*Pharmaceutical Biotechnology* and *Pharmaceutical Parasitology and Microbiology*) were developed for both Master's and Ph. D. students. The courses were well taken by the students and industries.

- (a). Supervised/supervising the **Ph. D.** thesis work of the following students. The titles of their thesis are:
1. "Vaccination of mice against *Plasmodium yoelii nigeriensis* and characterization of the protective monoclonal antibodies". (**Degree awarded, 2002**; SRF: CSIR).
  2. "Experimental studies on neuroimmunomodulation in visceral leishmaniasis". (**Degree awarded, 2004**; JRF/SRF: CSIR, NET).
  3. "Acute-phase reactants in murine tuberculosis: cellular and molecular studies". (**Degree awarded, 2005**; JRF/SRF: CSIR, NET).
  4. "Bioimmunotherapy of rodent malaras: elucidation of cellular and molecular mechanisms" (**Degree awarded, 2007**; JFR: CSIR, NET).
  5. "Chemotherapeutic and immunological studies during tuberculosis and malaria co-infection: a rodent model" (comprehensive examination cleared; thesis submission in next 04 months; JRF: CSIR NET, ICMR) "Molecular and cellular approaches to target tuberculosis" (JRF: CSIR, NET).
  6. "Studies on some cellular and molecular mechanisms of pathogenesis in tuberculosis" (continuing; JRF: CSIR NET)
  7. "Hybridomic elucidation of antimalarial immune response" (to join soon; CSIR grant)

*Serial No. 1 student was registered under Biotechnology programme, the remaining four students were/are under Pharmacology and Toxicology programme.*

- (b). **Twenty**, Master's degree students have been **awarded** their **M. S.** (Pharm.) *Biotechnology* (Sr. No. 1-4) and the remaining *Pharmacology and Toxicology* degrees. The titles of their theses are:
1. "Molecular mechanisms in pathogenesis in malaria: role of colony-stimulating factors".
  2. "Vaccination of mice against *Plasmodium yoelii nigeriensis*".
  3. "*Plasmodium berghei* infection in mice: serum amyloid P-component response and its role in enhanced erythrophagocytosis".
  4. "Morphine-induced immunomodulation in *Plasmodium yoelii nigeriensis*-infected mice".
  5. "Selection and cloning of artemisinin and artemisinic acid resistant strains of rodent malaria parasites".
  6. "Neuroimmunomodulatory effects of morphine in murine tuberculosis".
  7. "Determination of blood-schizontocidal activity of macrolide antibiotics against rodent malaras: stand alone and adjunct".
  8. "*Leishmania donovani* infection in hamsters: chemotherapy and selection of a miltefosine-resistant strain".

9. "Experimental studies on the efficacy of nitazoxanide against *Trichomonas vaginalis*".
10. "Possible reduction of miltefosine curative doses by co-administration of recombinant human granulocyte-macrophage colony-stimulating factor and methionine-enkephalin: a rodent visceral leishmaniasis study".
8. "Allicin treatment of rodent malaria: stand alone and in combination with curcumin and artemisinin".
9. "Evaluation of *in vitro* efficacy of satranidazole against *Mycobacterium tuberculosis* in latent state under oxygen depletion conditions".
10. "Determination of the immunomodulatory effects of morphine on experimental immunization using a rodent malaria vaccination model".
11. *Trichomonas vaginalis*: *in vitro* cloning and drug susceptibility testing".
12. "Comparative evaluation of the antimycobacterial activity of satranidazole in hypoxic and carbon starvation models, *in vitro*".
13. "Determination of the activity of triclosan against *Trichomonas vaginalis*, *in vitro*".
14. "Determination of the combined effect of probenecid, proguanil and dapson in *Plasmodium berghei*-infected mice".
15. "Assessment of nelfinavir in *Leishmania donovani*-infected golden hamsters" (ongoing)
16. "To investigate the antileishmanial effect of amiodarone against *Leishmania donovani* infection in golden hamsters" (ongoing)
17. "To investigate the combination effect of miltefosine and 3,3'-di indolyl methane against *Leishmania donovani* infection in hamsters" (ongoing)
18. To study the effect of atorvastatin on the antimalarial activity of artesunate against *Plasmodium yoelli nigeriensis* infection in mice" (ongoing)
19. "Antimalarial activity assessment of farnesol in *Plasmodium yoelli nigeriensis* infected in mice" (ongoing)
20. "Study of the effect of the combination of risedronate and azithromycin in a rodent malaria model" (ongoing)

(c). Supervised the Summer Training Programme work of M. Sc. (Microbiology and Biotechnology) students from Panjab University, Chandigarh; Kurukshetra University, Kurukshetra and Banasthali Vidya Peeth, Banasthali. The titles of their projects are:

1. Hybridoma technology: maintenance of myeloma cell line and a hybrid.
2. Cultivation of mouse bone-marrow cells and the determination of colony-stimulating factors.
3. Vaccination against rodent malaria.
4. Mouse splenic macrophages: cultivation and determination of phagocytic activity.
5. Production of phagocytosis promoting lymphokines.
6. Hybridoma technology: maintenance of myeloma cell lines and production of a hybrid.
7. Determination of rosette formation during *Plasmodium yoelli nigeriensis* infection in mice.

8. Detection of antimalarial antibody by enzyme-linked immunosorbant assay.
9. Fluorescence microscopy of malaria parasites.
10. Mycobacteria-macrophage interaction.
11. Vaccination against *P. yoelii nigeriensis*: antigen preparation, protein estimation, immunization and assessment of protection.
12. Chemotherapy and drug resistance in malaria: a rodent model.

(d). Taught the following Courses to M. S. (Pharm.) and Ph. D. students:

1. BT-510 (Biotechnology in Pharmaceutical Sciences)
2. BT-511 (Immunochemical/Radiochemical Methods of Analysis)
3. BT-630 (Immunology and Immunotechnology)
4. BT-640 (Applied Microbiology and Fermentation Technology)
5. BT-650 (Diagnostics)
6. PC-540 (Chemotherapy of Parasitic and Microbial Infections)
7. PC-611 (Pharmacological Screening)
8. PC-660 (Chemotherapy)
9. BT/PC-720 (Ph. D. course: Application of Biotechnology in Parasitic Disease Research).
10. PC-740 (Ph. D. course: Cellular and Molecular Parasitology)
11. PC-830 (Ph.D. course: Parasitology/Microbiology, community and Pharmacy).
12. Laboratory practical.
13. Seminars

**Course coordinator:** BT-510, BT-511, BT-630, BT-640, BT-650, GE-511, PC-540, BT/PC-720, PC-740 and PC-830.

**Examiner of Ph. D. theses:**

1. “Modes of action and mechanisms of resistance to promomycin in visceral leishmaniasis”, (2009), Dept. of Life Sciences, Jawaharlal Nehru University, New Delhi.
2. “Studies on phytochemical and pharmacological activity *Scoparia dulcis* Linn”, (2008), Institute of Pharmacy, Bundelkhand University, Jhansi.
3. “Characterization and conformational studies of high mobility group box (HMGB) proteins of *Plasmodium falciparum*”, (2008), Dept. of Biosciences, Jamia Millia Islamia, New Delhi.
4. “Studies on glutathione reductase and thioredoxine reductase of *Plasmodium berghei*”, (2007), Dept. of Biosciences, Himachal Pradesh University, Shimla.
5. “Cloning, expression, purification and immunization studies of MSP-1 19 and MSP-1 42 (vaccine candidate antigens) of *Plasmodium falciparum* and *P. vivax*”, (2006), Dept. of Zoology, University of Delhi, Delhi. Also, the examiner to conduct the *viva voce* of this student.

6. "Isolation and characterization of some antigens of *Plasmodium berghei*", (2006), **Dept. of Biosciences, Himachal Pradesh University, Shimla. Also, the examiner to conduct the viva voce of this student.**
7. "Detoxification of heme by *Plasmodium falciparum* histidine-rich proteins and its inhibition by quinoline antimalarial drugs", (2003), **Dept. of Zoology, University of Delhi, Delhi.**
8. "Selection of antimalarial resistant lines of *Plasmodium yoelii* and sporogonic studies in *Anopheles stephensi*", (2003), **Dept. of Zoology, University of Delhi, Delhi.**

**Examiner of M. Sc. thesis:**

1. "Effect of cigarette smoke inhalation and/or  $\alpha$ -tocopherol on pulmonary lipid peroxidation and DNA fragmentation in male BALB/c mice", 2001, **Dept. of Biophysics, Panjab University, Chandigarh.**

**Human resource development activities** (recognition/honor/award received by P.G./Ph. D. scholars ):

- A. One Ph. D. student was selected for "First Winter School in Immunology in India", organized by Dr. V. S. Kanury Rao, International Center for Genetic Engineering and Biotechnology at Kovalam, Kerala from Feb. 8-13, 2001.
- B. One Ph. D. student was awarded a Travel Grant by CSIR, New Delhi, to present an oral paper at UK. The Organizers waived the Registration fee.
- C. One Ph. D. student has been awarded a Post-doctoral Fellowship in USA.
- D. Three Ph. D. students were selected (and participated) in two different International Training programmes in India. They were provided full financial support.
- E. One Ph. D. student has joined as Lecturer at the Dept. of Microbiology, Guru Nanak Dev University, Amritsar, Punjab.
- F. Two Ph. D. students have been appointed Scientists in two different National Pharmaceutical Industries.
- G. Seven P.G. students have joined scientific positions in National Pharmaceutical Industries.
- H. One foreign P.G. student has done master's degree work on malaria and is working as a lecturer in Ethiopia.
- I. One Ph. D. student has been awarded DBT fellowship to work on tuberculosis in Seattle, Washington, USA.

**PRODUCTS DEVELOPED/IDENTIFIED:**

1. Anti-*Plasmodium yoelii nigeriensis* monoclonal antibodies. (For details please see product section "**Monoclonal Antibodies**" in *Hybridoma and Hybridomics*, 2003, Vol. 22 (3), 61)
2. Was involved in the pre-clinical development of anti-amoebic drug **satranidazole**.
3. Identified **four** novel 8-aminoquinolines as broad spectrum antimalarials in rodent malarias and *P. falciparum*, *in vitro*. These compounds have been synthesized at

NIPER and have been patented. Their evaluation in non-human primate malarial is awaited.

4. As part of the ongoing Indo-European Union FP7 funded project titled “New Approaches to Target Tuberculosis”, 34 compounds have been found to be active against *Mycobacterium tuberculosis* H37Rv (by BACTEC 460 method) at 6.25 µg/mL(IC99). Six of these compounds have shown MIC values of  $\leq 0.39$  µg/ml.
5. Dapsone (DS)-chlorproguanil combination (Lapdap™), though effective against human malaria parasite *Plasmodium falciparum*, has been reported to reduce hemoglobin concentration in patients with glucose-6-phosphate dehydrogenase deficiency due to dose-related toxicity of DS component. We have observed that (1) probenecid (PB) is a blood-schizonticidal agent and (2) it synergizes with both DS and proguanil (PG). A combination of all the three agents also resulted in synergism, and reduced the required dose of DS, as compared to DS stand-alone, by 10.17-fold. This first report of the *in vivo* antimalarial activity of PB suggests that it can be used as a new therapeutic agent to reduce dose-related toxicity of DS.
6. Triclosan, at 50 µg/ml (minimal inhibitory concentration; MIC), was observed to be active against both the metronidazole-sensitive and -resistant strains of *T. vaginalis*, *in vitro*; the MICs of metronidazole against both these strains was 1.6 µg/ml and 4.8 µg/ml, respectively. The results of this first study demonstrate that triclosan may be a promising potential agent for the treatment and management of human trichomoniasis.

### CONCEPTS CREATED

1. Bioimmunotherapy of malaria using rmGM CSF and met-enkephalin co-treatment.
2. Opioids as potential drugs for the treatment of microbial and parasitic diseases.
3. Generation of a qualitatively distinct dichotomous immune response to malaria in vaccinated/protected mice, which probably ensued in the generation of MAbs with functional heterogeneity.
4. Involvement of macrophage mannose 6-phosphate receptors in the uptake of *Mycobacterium tuberculosis*.
5. Role of pentraxins in host defense from tuberculosis.

### PROCESSES/MODELS/METHODOLGY/TECHNOLGY DEVELOPED

1. Developed a new rodent model for the screening of potential luminal amoebicides.
2. Developed a new rodent malaria (*P. yoelli nigeriensis* /mouse) vaccination model. *As this parasite causes a fulminating 100% lethal infection in mouse, vaccination-induced protective immunity can be very clearly distinguished from slow-grade infection- induced immunity.*
3. Antigen-induced production of CSFs by macrophages *in vitro*, as a model for the biological evaluation of potential immunomodulators. *Extensive publication in high-impact journals have made on this new model.*

## NATIONAL RESEARCH PROJECTS

1. Determination of possible linkage between antigenic variation and drug-resistance in *Plasmodium falciparum*, *in vitro*. CSIR, New Delhi. (PI; Mar. 2000 – Feb. 2003; Rs. 10.53 lakh)
2. Bioimmunotherapy of rodent malaria: evaluation of recombinant granulocyte-macrophage colony-stimulating factor and methionine-enkephalin co-treatment. DBT, New Delhi. (P I; Mar. 2003 – Feb. 2006; Rs. 20.12 lakh)
3. Acute-phase reactants during *Mycobacterium tuberculosis* H37Rv infection in mice: induction kinetics, and their role(s) in immunoregulation and host-defense. ICMR, New Delhi. (P I; Jan. 2004 – Dec. 2006; Rs. 10.77 lakh)
4. Hybridomic elucidation and molecular characterization of antimalarial immune response: a rodent model. CSIR, New Delhi. (PI; Apr. 2009 – Mar. 2012; Rs. 21.65 lakh).
5. Got **Rs. 903 lakh** for a five year proposal submitted (Rs. 12. 44 crore) to the Ministry of Chemicals and Fertilizers for XI Five Year Plan (2007-2012) to start a new Department of Pharmaceutical Parasitology and to expand and modernize the existing small base of pharmaceutical parasitology research and education at NIPER.
6. Pentraxins and innate immunity to tuberculosis. DBT, New Delhi. (Rs. 59 lakh; SUBMITTED in collaboration with L. R. S. Institute of TB & Respiratory Diseases, New Delhi). (Under revision)

## INTERNATIONAL RESEARCH PROJECT

1. **Indo-European Union Seventh Framework Programme (FP7)**. Project titled *“New Approaches to Target Tuberculosis”* has now been **funded** in collaboration with **Dr. Piet Herdewijn** (Coordinator; K. U. Leuven, Belgium), **Dr. S. H. E. Kaufmann** (Max-Planck Institute for Infection Biology, Germany), **Dr. Marino Zerial** (Max-Planck Institute of Cell Biology and Genetics, Germany), **Dr. Elaine Davis** (Div. of Mycobacterial Research, National Institute for Medical Research, UK), **Dr. Matthias Wilmanns** (EMBL, Germany), **Prof. Jyoti Chattopadhyay** (Bioorganic Chemistry Dept., Uppsala University, Sweden), **Prof. Prati Pal Singh** (National Institute of Pharmaceutical Education and Research, Mohali), **Dr. Rajesh Gokhale** (National Institute of Immunology, India) and **Dr. Ram Upadhyaya** (Institute of Molecular Medicine, Pune). *The project is now operational since October 01, 2008.*
2. **A no cost project** (with Prof. Branka Zorc, Zagreb, Croatia) on the screening of potential antimalarial compounds is operational for last 02 years. Nearly 50 compounds have been tested. Out of this work, one paper has been communicated for publication and the other shall be sent soon.
3. A collaborative research programme with Prof. Drik Schluter, Otto-van Guericke Univ., Magdeburg, Germany, has been initiated for the development of a new rodent cerebral malaria model using KO mice. The agreement is expected to be signed shortly.

**INVITED LECTURES:** Forty one

**SCIENTIFIC SESSIONS CHAIERD:** Fifteen

**INDUSTRY ASSOCIATIONS:** Presently, **Technical Services Agreements** with two pharmaceutical companies viz. M/s. Institute of Molecular Medicine, Kolkata and M/s. Advanced Enzyme Technologies Limited, Thane, are operational. Agreements with two more industries are being negotiated and will be signed, soon.

**PATENTS (Actually granted; US, one; Europe, one)**

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**PUBLICATIONS** (total **195**; research papers, **82**; abstracts, **110**; editorials, **03**; in reverse chronological order)

(*NatureIndia* published a research highlight titled ““A shot of morphine to treat TB””; doi:10.1038/nindia.2008.110; published online 31 January 2008).

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