

**c. Statement of research achievements, if any, on which any award has already been received by the applicant. Please also upload brief citation(s) on the research work(s) for which the applicant has already received the award(s) (not to exceed 2000 words).**

**Dr. Mukhopadhyay has received following awards based on her research work on “*Effect of reactive oxygen species (ROS) on immune system and modulation of protective immune response of host during tuberculosis*”.**

- 1. National Young Woman Bioscientist Award (2007)** by the Department of Biotechnology (DBT), Govt. of India.
- 2. National Bioscience Award for Career Development (2008)** by the Department of Biotechnology (DBT). Govt. of India.
- 3. Kshanika Oration Award (2009)** by the Indian Council of Medical Research (ICMR), Govt. of India.
- 4. Basanti Devi Amir Chand Prize (2011)** by the Indian Council of Medical Research (ICMR), Govt. of India.
- 5. Chaturvedi Ghanshyam Das Jaigopal Memorial Award (2015)** by the Indian Council of Medical Research (ICMR), Govt. of India.
- 6. TATA Innovation Fellowship (2017-2018)** by the Department of Biotechnology (DBT). Govt. of India.

#### **Detail Research Work:**

Reactive oxygen species (ROS), generated during the innate immune response are considered to be important anti-microbial agents. However, in some infectious diseases like tuberculosis, overproduction of ROS ‘per se’ do not kill *Mycobacterium bacilli* but rather are involved in exacerbating the disease, indicating that ROS may actually favor pathogen survival by dampening the host’s protective immune responses. During the quests to understand the molecular basis of such intrigued function of ROS, Dr. Mukhopadhyay demonstrated and established an immunoregulatory role of ROS. Her group for the first time demonstrated an existence of a dichotomous regulation between the production of free radicals/ROS by ‘macrophages’ and ‘T cell priming responses’. Her research in this area revealed that excessive free radicals/ROS

generated in body due to high oxidative stress during chronic infection like tuberculosis and other patho-physiological disorders like cancer can directly hamper the protective immune responses of the body by inhibiting the Interleukin-12 induction and consequently T-helper 1 T cell response to trigger immunosuppression (*Khan et al.,[2006] Blood 107:1513; Boddupalli et al.,[2007] Free Radical. Biology and Medicine 42:68*). This is considered to be a significant finding in the field of immunology, because it addresses the issue of the relationship between the production of antimicrobial ROS and that of IL-12, an immunoregulatory cytokine that activates NK and T cells for inducing cell-mediated immunity against intracellular pathogens like tuberculosis or fighting against cancer. The data suggest use of antioxidants to combat these patho-physiological disorders (*J. Immunol[2010]*). Further studies by her indicate that the T-cell activation and priming responses is also suppressed by free radicals. The ROS are also found to inhibit antigen processing and presentation without affecting the costimulatory signaling, thus can greatly influence T cell proliferation and effector responses. All these observations provide some critical clues to understand the molecular mechanism of immunosuppression during tuberculosis and/or infections by other intracellular pathogens. This part of work received **National Young Woman Bioscientist Award (2008) and National Bioscience Award for Career Development (2008)** by DBT, Govt of India. These may also augur well to understand other immunosuppression related diseases like cancer where IL-12/Th1-dominated immune response is important to mount a protective immune response. Thus an approach is initiated to tailor macrophages for increased IL-12 induction and Th1 response which could be a better therapeutic tactic to control tuberculosis and other pathophysiological disorders. Dr. Mukhopadhyay showed that manipulation of glutathione-redox status towards reducing environment (using cell permeable glutathione ethyl ester [GSH-OEt] or N-acetyl cysteine [NAC]) can increase IL-12 induction and improve anti-BCG Th1 response in PBMC cultures obtained from active TB patients (*Alam et al.[2010] Journal of Immunology 184:2918*). This study provide valuable insights on pharmacologically regulating IL-12 induction and anti-BCG Th1 response by manipulating glutathione-redox balance in macrophages. These studies provide novel angle that will be helpful in designing meaningful strategies for activation of immune response to cure and prevent a large spectrum of diseases including infectious, metabolic, and neoplastic diseases (*Das and Mukhopadhyay[2011] Endocrine, Metabolic & Immune Disorders - Drug Targets 11:23*). This study received the **Kshanika Oration Award, (2009) by ICMR, Govt. of India**'. Part of the work by which *M. tuberculosis* can dampen the

adaptive (CD4 Th1 and CD8) T cell response is recognized by ICMR, Govt. of India by bestowing the ‘ICMR **Basanti Devi Amir Chand Prize (2011)** and **Chaturvedi Ghanshyam Das Jaigopal Memorial Award (2015)**’.

In the area of tuberculosis research, Dr. Mukhopadhyay has major leads in understanding the toll-like receptor 2 (TLR2) signaling in the pathogenesis of tuberculosis. She showed that PPE18 (Rv1196) protein of *M. tuberculosis* is a strong anti-inflammatory protein that activates IL-10 and subsequently inhibits the protective IL-12 and tumor necrosis factor-alpha (TNF- $\alpha$ ) cytokines and skews the T cell response towards the Th2-type during tuberculosis. Results from her experiment indicate that PPE18 specifically interacts with LRR 11~15 domain of TLR2 to increase IL-10 induction and a skewed-Th2 response. Thus TLR2 11~15 domain is targeted to design small molecule inhibitors to block interaction of PPE18 and other similar protein in order to block excess Th2-type response. This part of the work is awarded with the **TATA Innovation Fellowship (2017-2018)** by DBT, Govt of India.



Government of India  
Ministry of Science and Technology  
Department of Biotechnology

PRESENTS

**NATIONAL YOUNG WOMEN BIOSCIENTIST  
AWARD 2007**

TO

**DR. SANGITA MUKHOPADHYAY**  
CENTRE OF DNA FINGERPRINTING & DIAGNOSTICS, HYDERABAD

*in recognition of her pioneering work in understanding the mechanism of feed-back regulatory role of free radicals on the immune system. Dr. Mukhopadhyay has demonstrated that free radicals, produced in excess during stress, have an immuno-modulatory function that involves downregulation of IL-12 through inhibition of c-rel translocation.*

Given this Day the 8<sup>th</sup> of March 2008 at the function organized in connection with the International Women's Day.

**SMT. PRATIBHA DEVISINGH PATIL**  
HONORABLE PRESIDENT OF INDIA



सत्यमेव जयते

Government of India  
Ministry of Science and Technology  
Department of Biotechnology

PRESENTS

**NATIONAL BIOSCIENCE AWARD FOR  
CAREER DEVELOPMENT 2008**

TO

**DR. SANGITA MUKHOPADHYAY**  
CENTRE FOR DNA FINGERPRINTING AND DIAGNOSTICS,  
HYDERABAD

*in recognition of her pioneering work on modulation of macrophage signaling and immune-effector responses when challenged with infection/stress. Her research work include understanding the signaling pathways involved in regulation of cytokines and free radicals in activated macrophages and how candidate virulent proteins of Mycobacterium tuberculosis modulate these signaling pathways favoring survival of the bacilli inside host.*



**K. VIJAYRAGHAVAN**  
SECRETARY  
DEPARTMENT OF BIOTECHNOLOGY



**S. JAIPAL REDDY**  
MINISTER FOR SCIENCE & TECHNOLOGY  
AND EARTH SCIENCES





# Indian Council of Medical Research

## ICMR Kshanika Oration Award

### CERTIFICATE

*This is to certify that*

*Dr Sangita Mukhopadhyay, Centre for DNA Fingerprinting and  
Diagnostics, Hyderabad has been awarded ICMR Kshanika Oration  
Award for her research work in the field of Biomedical Sciences  
for the year 2009*

*Yashwantrao Chavan*

*(Dr V.M. Katochi)*

*Secretary, Department of Health Research*

*MOH&FW, Government of India & Director-General, ICMR, New Delhi*





# Indian Council of Medical Research

## Basanti Devi Amir Chand Prize

### CERTIFICATE

This is to certify that  
Dr Sangita Mukhopadhyay, Centre for DNA Fingerprinting  
and Diagnostics, Hyderabad  
has been awarded Basanti Devi Amir Chand Prize  
for her research work in the field of Biomedical Sciences for the Year 2011

  
(Dr. Soumya Srinaminathan)  
Secretary, Department of Health Research  
MOHFW, Government of India & Director-General, ICMR, New Delhi







# Indian Council of Medical Research

*ICMR Chaturvedi Ghanshyam Das Jaigopal Memorial Award*

## CERTIFICATE

*This is to certify that*

*Dr. Sangita Mukhopadhyay, Centre for DNA Fingerprinting and  
Diagnostics, Hyderabad has been awarded ICMR Chaturvedi  
Ghanshyam Das Jaigopal Memorial Award for her research work in the  
field of Immunology for the Year 2015*

*(Dr Soumya Swaminathan)*

*Secretary, Department of Health Research*

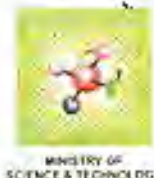
*MOHFW, Government of India & Director-General, ICMR, New Delhi*







सूचना का  
अधिकार



भारत सरकार  
विज्ञान और प्रौद्योगिकी मंत्रालय  
बायोटेक्नोलॉजी विभाग  
ब्लॉक-2 7 वां तल, सी० जी० आर० कॉम्प्लेक्स  
लोदी रोड, नई दिल्ली-110003  
GOVERNMENT OF INDIA  
MINISTRY OF SCIENCE & TECHNOLOGY  
DEPARTMENT OF BIOTECHNOLOGY  
Block-2, 7th Floor C.G.O. Complex  
Lodi Road, New Delhi-110003

Dr. Arun Kumar Rawat  
Director  
Ph. 011-24369614 (O)  
Email: akrawat@dbt.nic.in

D.O. NO. BT/HRD/35/01/03/2018

Dated: 18.05.2018

Dear Dr. Mukhopadhyay,

I am pleased to inform that you have been selected for the prestigious Tata Innovation Fellowship of the Department of Biotechnology, Government of India for the year 2017-18 in recognition of your outstanding research contributions. The fellowship is meant to honour and encourage scientists involved in translational research dedicated to finding solutions by innovative scientific knowledge and platform technologies.

As per the terms of the Award, to begin with you will receive a fellowship amount of Rs. 25,000/- per month (in addition to the regular salary from your institute) and a contingency grant of Rs. 6.00 lakhs per year, for a period of three years.

On behalf of the Department of Biotechnology and on my personal behalf, please accept our heartiest congratulations and best wishes. Terms and conditions for availing the fellowship are enclosed. Kindly send your acceptance before the formal sanction order is issued along with signed terms & conditions and bank details.

With regards,

Yours sincerely,

*A.K. Rawat*

(A.K. Rawat)

Encl: As above.

Dr. Sangita Mukhopadhyay  
Staff Scientist VI and Group Leader,  
Laboratory of Molecular Cell Biology,  
Centre for DNA Fingerprinting and Diagnostics,  
Inner Ring Road,  
Uppal, Hyderabad- 500039

Copy to:

The Director,  
Centre for DNA Fingerprinting and Diagnostics,  
Inner Ring Road,  
Uppal, Hyderabad- 500039

*A.K. Rawat*

(A.K. Rawat)

# THE NATIONAL ACADEMY OF SCIENCES, INDIA



**DR. SANGITA MUKHOPADHYAY**

*has been elected*

**FELLOW**

*of*

*The National Academy of Sciences, India*

*in the year 2010*

*for his contributions in the field of*

**IMMUNOLOGY/TUBUCULOSIS (INFECTION)/CELL SIGNALING.**

*Krishna Misra*

*Jitendra Khurana*

GENERAL SECRETARIES

*Asis Das*

PRESIDENT





# INDIAN ACADEMY OF SCIENCES FELLOWSHIP

This is to certify that

*Sangita Mukhopadhyay*

was elected to the Fellowship  
of the Indian Academy of Sciences  
in the year 2013 in recognition of  
outstanding contributions to science.

*Imaitra V. Venkesh*  
Secretaries

*Chamrasnam*  
President



भारतीय राष्ट्रीय विज्ञान अकादमी

Indian National Science Academy



FOUNDED IN 1935

**Sangita Mukhopadhyay**

*has been elected*

Fellow of

the Indian National Science Academy

*at*

*the Annual General Meeting*

*on October 14, 2015*

*[Signature]*

*R. Satapathy*

# Telangana Academy of Sciences

Osmania University Campus, Hyderabad, Telangana, India



Elects

**Dr. Sangita Mukhopadhyay**

CDFD, Hyderabad

as

*Fellow*

of the Academy in recognition of her  
contributions to Science & Technology

1<sup>st</sup> July 2017

  
Dr. Ch. Mohan Rao  
President

  
Prof. K. Narasimha Reddy  
Hon. Secretary