CSIR - INDIAN INSTITUTE OF TOXICOLOGY RESEARCH

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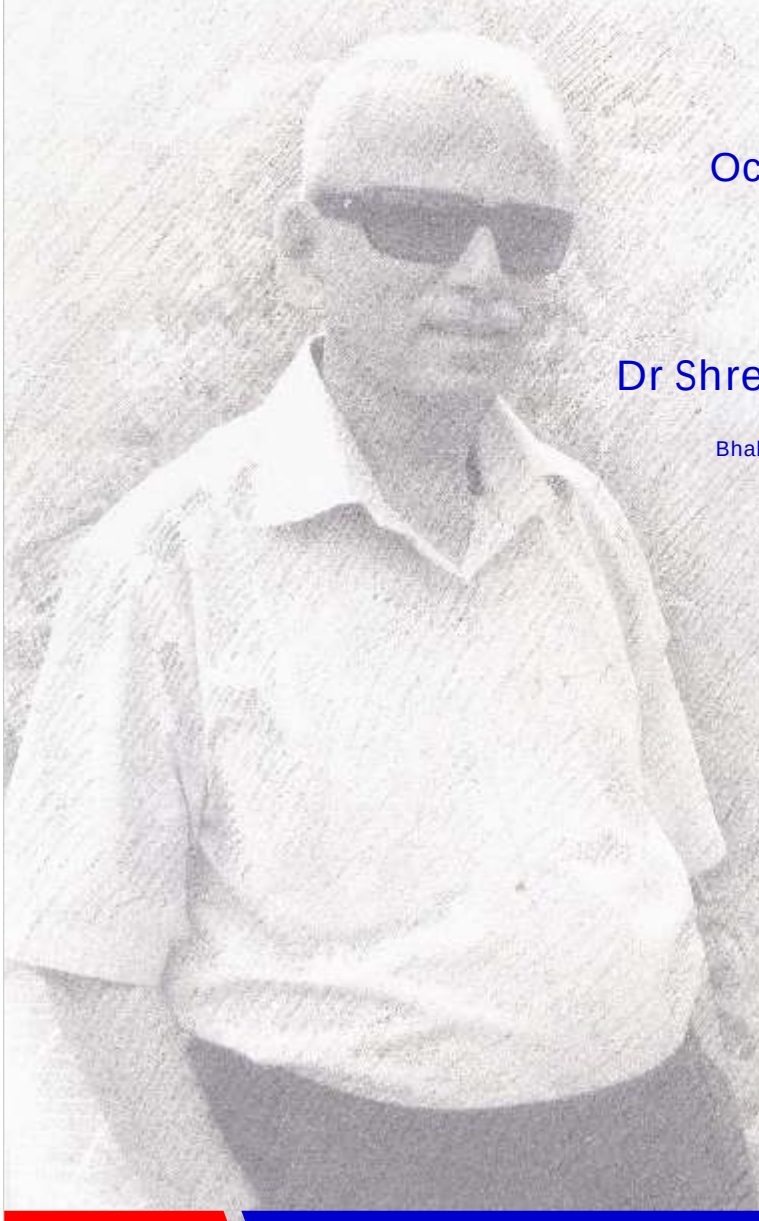
# Golden Jubilee Lecture



October 16, 2015


## Dr Shree Kumar Apte

Molecular Biology Division
Bhabha Atomic Research Centre
Mumbai, India


1965 2015 स्वर्ण जयन्ती

50 Years of Service to the Nation

# Dr S. K. Apte

Dr. Shree Kumar Apte obtained his Masters in Botany with a Gold Medal in Science Faculty from the Jiwaji University, Gwalior in 1972 and a Ph.D. in Botany from Gujarat University, Ahmedabad in 1985. After graduating in Biology and Radiobiology discipline from the 16$^{th}$ batch of BARC Training School in 1973, he joined the Bio-Medical Group at BARC where he has been working for the last 42 years. Dr. Apte recently superannuated as a Distinguished Scientist and Director of the Bio-Science Group at BARC, He is currently serving as Emeritus Professor, HBNI-DAE and as Raja Ramanna Fellow at BARC, Mumbai..

His research interests include unraveling responses of organisms to ionizing radiations and other environmental stresses and development of eco-friendly biotechnologies for agricultural applications and for bioremediation of nuclear waste. He has also been overseeing BARC research activities on *"effects of high background natural radiations on human populations living in Kerala, India" and on "use of radiation technologies for crop improvement and for food preservation". He served as India's Representative at United Nation's Scientific Committee on Effects of Atomic Radiations (UNSCEAR) in 2014.* He is a member of several national committees of DST, DBT, CSIR, ICAR, INSA and DAE and the Genetic Engineering Appraisal Committee (GEAC) of MoE&F. He is actively engaged in popularization of science and in programs to enhance public awareness about nuclear energy, in particular.

Dr. Apte has published over 180 research papers. He is an elected fellow of all three National Science Academies and also the National Academy of Agricultural Sciences, in India. He was awarded the IAEA Fellowship in 1976-77; the Nuffield Foundation Fellowship, U.K in 1984; and the USAID Fellowship, USA in 1988-89. He is also a recipient of Prof. J.V. Bhat-Eureka Forbes Award for Excellence in Microbiology, 1990; Young Scientist Award in Cyanobacterial Biotechnology, 1996; Prof. K. S. Bilgrami Memorial Award of INSA in 2006, and Indian Nuclear Society Award, 2006.

# Genetic Engineering of Deinococcus radiodurans for uranium bioremediation from radioactive, acid/alkaline aqueous waste

**Shree Kumar Apte**
Molecular Biology Division
Bhabha Atomic Research Centre, Mumbai, India

In nature, uranium occurs over a wide range of concentrations and is generally toxic to all living cells. Natural causes and anthropogenic treatments generate acid/alkaline (and often radioactive) aqueous waste, wherein uranium is found at rather low (<1-2mM) concentration. Removal of even such low concentrations of uranium is essential for safe disposal of the waste, but is difficult to achieve by regular physico-chemical methods. Microbial bioremediation, especially bioprecipitation as insoluble uranyl phosphate, is an efficient way to remove uranium from such waste. A few microbes in nature are endowed with such capability but perish in nuclear waste, where high levels of radiations also prevail. Our laboratory has genetically manipulated the extremely radioresistant microbe, Deinococcus radodurans, to individually over-express acid and alkaline phosphatases from strong deinococcal promoters, including a radiation-induced deinococcal $P_{ssb}$ promoter. The constructed recombinant strains individually expressed either high acid phosphatase or alkaline phosphatase activities and precipitated >90% uranyl nitrate at pH 5-7 or uranyl carbonate at pH 8-10, from 1 mM uranium concentration in 5-6 hours. The strains were equally capable of precipitating much higher uranium concentrations (5-20 mM), provided higher concentrations of the organic phosphate donor were provided. At 10 mM uranyl concentration cells could remove 7-11 g U/g dry weight of the biomass. Lyophilisation preserved both the phosphatase activities and uranium precipitation ability of recombinant cells up to 1 year at ambient temperature. While under acidic/neutral pH the precipitated uranium remained cell-bound and could be easily removed, under alkaline conditions the precipitation occurred extracellularly in solution. Lyophilised and immobilised recombinant cells, could successfully remove and retain precipitated uranyl phosphate in alginate beads at alkaline pH, both in a batch process as well in a flow-through system. The technology offers an eco-friendly, promising solution for bioremediation of toxic uranium from aqueous waste in high radiation environments.

# CSIR-INDIAN INSTITUTE OF TOXICOLOGY RESEARCH

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**CSIR-IITR, Lucknow is the only multidisciplinary research institute in the field of toxicology in South East Asia with the motto:**

*Safety to Environment & Health and Service to Industry*

## R&D Areas

- Food, Drug & Chemical Toxicology
- Environmental Toxicology
- Regulatory Toxicology
- Nanotherapeutics & Nanomaterial Toxicology
- Systems Toxicology & Health Risk Assessment

## Recognitions

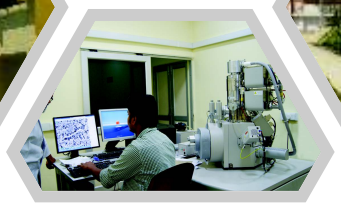
- Scientific & Industrial Research Organizations (SIROs)
- UP Pollution Control Board (Water & Air)
- Indian Factories Act (Drinking Water)
- Bureau of Indian Standards (Synthetic Detergents)
- Food Safety & Standards Authority of India (FSSAI)

## Services Offered

- GLP certified for pre-clinical toxicity studies
- NABL accredited
- Safety / toxicity evaluation of NCEs
- Water quality assessment and monitoring
- Analytical services
- Environmental monitoring and impact assessment
- Epidemiological studies
- Information on chemicals / products

## Technologies Developed / Available

- Water Analysis Kit
- Mobile Laboratory Van for on spot water quality analysis
- Argemone Detection Kit for rapid screening of Argemone in mustard oil
- CD-Strip for detection of butter yellow, an adulterant in edible oils
- Arsenic Detection Kit




Director

CSIR-Indian Institute of Toxicology Research

विषविज्ञान भवन, 31-महात्मा गांधी मार्ग, पोस्ट बाक्स नं० 80, लखनऊ-226001, उ.प्र., भारत

VISHVIGYAN BHAWAN, 31-MAHATMA GANDHI MARG, POST BOX NO 80, LUCKNOW-226001, U.P., INDIA

Phone:+91-522-2627586, 2614118, 2628228 Fax:+91-522-2628227, 2611547

director@iitrindia.org www.iitrindia.org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