

## K. Sundaram (1926–2008)

Krishna Sundaram was born on 28 October 1926 in Kollengode, Kerala. He had his schooling in South-India Education Society School at Sion, Mumbai and later joined Elphinstone College, Mumbai. He obtained his MBBS degree in 1949 and MD (Obstetrics and Gynaecology) from G. S. Medical College (KEM Hospital), Parel, Mumbai in 1953 with a Prince of Wales Gold Medal. He briefly practised as a gynaecologist, but soon stopped as he found it difficult to charge patients who were mostly poor.

Sundaram joined BARC in 1957 as a Scientific Officer and started working in radiation biology. He was interested in cytology, genetics, immunology, nuclear medicine and the effects of high background radiation in Kerala. His early work related to the effects of radiation on reproductive performance of animals. During 1960–61, he went to University of Rochester, USA. His work on the etiological factors associated with toxæmia of pregnancy has received international recognition. It implicated mineral corticoids, later identified as aldosterone, as a causative factor in fluid retention and hypertension. Sundaram was perhaps the first scientist in the country to apply exfoliative cytology techniques in the diagnosis of cancer and prognosis in radiotherapy. His original work on the predisposing factors in the development of oral cancer in experimental animals highlighted the importance of nutritional deficiencies of protein and B-group vitamins in its etiology. He showed, for the first time, that though radioprotective chemicals could reduce immediate mortality, the risk of the survivors to the development of cancers was enhanced.

Sundaram became Head of the Medical Division and engaged himself full time in research. He was sharp and intelligent and grasped the nuances of basic sciences easily. In 1971, he became the Director of the Bio-Medical Group.

In 1965–66, Jack Ambrose, Chester Beatty Research Institute, London arrived at BARC as a visiting scientist. He brought along with him the technique and apparatus of cell electrophoresis (migration of live cells under the influence of an electric field). Here began the long association between Sundaram and Bal Phondke. In 1967, they published the first paper describing electrophoretic

mobilities of lymph-node cells of normal and immunized rats in *Immunology*. In the years to follow, several papers were published by Sundaram, Phondke and others demonstrating the usefulness of the technique of cell electrophoresis in studying the changes in cell surface of lymphocytes brought about by immunization, malignant transformation and interactions with antibodies and lectins in reputed journals. Their studies on anti-lymphocyte sera against immune cells led to the demonstration of immunosuppressive anti-idiotypic antibodies. With P. K. Ray and others, Sundaram co-authored many papers, related to the immunogenicity of cancer cells treated with an enzyme neuraminidase.



The studies on the effects of high natural background radiation always interested Sundaram. In 1975, he sent K. P. George and other associates to set up a cytogenetics laboratory in Chavara near Kollam, Kerala. This was the beginning of the MSP (Monazite Survey Project) and today a Low Level Radiation Research Laboratory stands well established for this purpose in Kollam. In 1976, a highly cited, yet controversial paper was published in *Nature*, by Kochupillai and others from AIIMS, New Delhi, describing the prevalence of Down's syndrome in children born in the HBRA, as against none in those born in normal background area. Sundaram, who also had a flair for statistical methodologies, contested these findings, pointing out that since the mother's age was not considered and there were no Down's cases in the NBR population, these conclusions were unacceptable. This letter was promptly published in *Nature*.

Another major and alarming controversy that Sundaram addressed head-on was the one arising from publications by National Institute of Nutrition (NIN), Hyderabad, which erroneously inferred

that consumption of irradiated wheat resulted in increased level of chromosomal aberrations (dicentric) in mice. He insisted on double-blind studies which were carried out at Mumbai and Hyderabad. These studies could not substantiate NIN's findings and a National Committee appointed by the Government and consisting of P. V. Sukhatme and P. C. Kesavan endorsed the findings of BARC, and found that the extensive long-term toxicological tests conducted by BARC were valid. This paved the way for the clearance of irradiation as a method of food processing and preservation by the Ministry of Health, and approval of several items for this purpose 15–20 years later.

This brought Sundaram into another new area of contemporary research – genetic toxicology and environmental mutagenesis. He became a member of the FAO/WHO/IAEA committee on the Safety Evaluation of Radiation Processed Food. His group carried out several projects for IAEA/WHO/FAO to evaluate the genotoxic effects of a variety of chemicals using micronucleus and chromosome aberration tests.

Sundaram was elected a Fellow of INSA, New Delhi; Indian Academy of Sciences, Bangalore; and Maharashtra Academy of Sciences. He was the founder-President of the Society of Nuclear Medicine, India. He represented India on the United Nations Scientific Committee on the Effects of Atomic Radiation from 1972 to 1986. He served as a member of the IV Committee of the International Commission on Radiological Protection and International Commission for Protection against Environmental Mutagens and Carcinogens. For three years (1979–82), Sundaram was the Director, Division of Life Sciences, IAEA, Vienna. During his tenure as the Director, BMG, BARC, Sundaram encouraged several youngsters in developing their careers. He was a keen and avid sportsman, and played tennis and cricket.

Sundaram died on 20 May 2008. He is survived by his wife, a son and a daughter.

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