

Editorial

Professor Saburo Fukui and his scientific achievement



Professor Saburo Fukui (1919–1998)

It is with deepest regret that we announce that Doctor Saburo Fukui, Professor Emeritus of Kyoto University, passed away on January 11, 1998, in Kyoto as a result of hepatic insufficiency.

Professor Fukui was born on July 31, 1919, in Takashima-cho, Shiga Prefecture, Japan, in a family of a Japanese sake brewer. He attended the Faculty of Engineering, Kyoto University where he received a degree of Bachelor of Engineering in 1942, and then took up graduate studies at the same university. In 1943, he married Michiru Odajima and they raised one son. Professor Fukui's first academic appointment was Instructor at the Department of Industrial Chemistry, Faculty of Engineering, Kyoto University in 1943. He was promoted to Lecturer in 1946 and then to Associate Professor in 1947 at the same department. The degree of

Doctor of Engineering was conferred on him in 1953 by Kyoto University through the thesis entitled "Studies on the relationship between B-group vitamins and microorganisms".

In 1954, he was promoted to full professor of the Department of Applied Chemistry, Himeji Technical University and then moved to Kyoto University in 1961 as professor of the Department of Industrial Chemistry, Faculty of Engineering. Professor Fukui supervised the Laboratory of Industrial Biochemistry for 22 years until his retirement from Kyoto University in 1983. In this year he was honored as Professor Emeritus of Kyoto University. After retirement, Professor Fukui served as president, chairman, director and so on of many societies, associations and foundations in Japan. His main scientific career is summarized in Table 1.

Starting as a chemist, Professor Fukui studied a wide area in microbial physiology, vitaminology, enzymology, fermentation and so on from the viewpoints of basic and practical aspects. In particular, his works on the structure–function relationship of vitamin B₆ and B₁₂ coenzymes, immobilization of biocatalysts, and microbial utilization of petrochemicals have been regarded as opening a new era in bioscience and biotechnology. Due to these scientific activities, Professor Fukui received the Honorary Doctor of Science from the Swiss Federal Institute of Technology (ETH Zurich). He also received several Orders from the French (1981 and 1995), German (1983) and Belgian (1990) governments due to his extensive international activities. The Second Order of the Sacred Treasure

Table 1

Main scientific career of Professor Saburo Fukui

Education

Graduated from the Department of Industrial Chemistry, Faculty of Engineering, Kyoto University (September 1942)

Conferred the degree of Doctor of Engineering (Kyoto University) (July 1953)

Career

Research Associate, Department of Industrial Chemistry, Faculty of Engineering, Kyoto University (May 1943)

Lecturer, Department of Industrial Chemistry, Faculty of Engineering, Kyoto University (December 1946)

Associate Professor, Department of Industrial Chemistry, Faculty of Engineering, Kyoto University (December 1947)

Professor, Department of Applied Chemistry, Himeji Technical University (January 1954)

Professor, Department of Industrial Chemistry, Faculty of Engineering, Kyoto University (April 1961)

Professor Emeritus, Kyoto University (1983)

Visiting Professor, Universite de Technologie de Compiègne, France (1978–1985)

Visiting Professor, Swiss Federal Institute of Technology, Switzerland (1983)

Guest Professor, Universitaet Goettingen (Germany) (1985)

Awards

Vitamin Society of Japan (Yamanouchi Prize) (May 1958)

Society of Fermentation, Osaka (Eda Prize) (October 1958)

Vitamin Society of Japan (April 1968)

Agricultural and Chemical Society of Japan (Suzuki Prize) (April 1974)

Ordre de Palme Academique (Chevalier) (France) (July 1981)

Bundes Verdienst Kreuz (1 Klasse) (West Germany) (May 1983)

Society of Fermentation Technology, Japan (November 1983)

German Fat Science Society (Normann Medal) (September 1987)

Honorary Doctor of Science, ETH Zurich (Switzerland) (November 1988)

Engineering Foundation, USA (Enzyme Engineering Award) (September 1989)

Insignia of Commander of the Order of the Crown of Belgium (July 1990)

The Second Order of the Sacred Treasure (Japan) (May 1993)

Officier dans l'Ordre National du Merite (France) (July 1995)

Academic activities

Vice President, Society of Fermentation Technology, Japan (1975–1977)

President, Society of Fermentation Technology, Japan (1977–1983)

Chairman, Japanese Society of Enzyme Engineering (1979–1985)

President, Vitamin Society of Japan (1981–1983)

Board of Trustees, CIBA-GEIGY Foundation (Japan) for the Promotion of Science (1987–1997)

President, Japan Bioindustry Association (1989–1997)

Vice Director, International Institute for Advanced Studies (1992–1997)

was awarded by the Japanese Government in 1993 in recognition of his distinguished achievements.

Some of his scientific activities are summarized below.

(1) Microbial production of vitamins and coenzymes, and structure–function relationship of coenzymes.

Based on the extensive search for producers of vitamins B₁, B₆, B₁₂ and so on, he established not only the fermentation procedures for production of various vitamins and coenzymes but also the microbial assay systems of vitamins B₆ and B₁₂, and elucidated biosynthetic routes

of them. In particular, the studies on application of petrochemicals such as *n*-alkanes and methanol as carbon sources to vitamin fermentation attracted worldwide attention. Fundamental studies on the roles of vitamins in microbial metabolism were practically applied to the control and improvement of sake making processes. On these achievement, Professor Fukui received the Yamanouchi Prize from the Vitamin Society of Japan and the Eda Prize from the Society of Fermentation, Osaka, Japan, in 1958.

Furthermore, he studied in detail the structure–function relationship of coenzyme B₆ and coenzyme B₁₂ by synthesizing their various new

analogues. The results obtained contributed deeply to the understanding of the functions of coenzymes in enzymatic reactions. These works were honored by the Vitamin Society of Japan in 1968 and the Agricultural and Chemical Society of Japan (the Suzuki Prize) in 1974.

(2) Microbial utilization of petrochemicals and studies on yeast peroxisomes.

To develop new carbon sources for microbial production of useful materials such as vitamins, coenzymes, enzymes and so on, he introduced petrochemicals like *n*-alkanes and methanol, and reported interesting results, which were highly evaluated in the world. During the course of these researches, he first discovered profuse appearance of peroxisomes (microbodies) in yeast cells assimilating these unconventional carbon sources. Professor Fukui elucidated the functions of the yeast peroxisomes, that is, the fatty acid β -oxidation and a part of the glyoxylate cycle in peroxisomes of *n*-alkane-utilizing yeast and the oxidation of methanol to formaldehyde in the organelles of methanol-utilizing yeast. These findings made a great influence on research of this type of organelles not only in other eukaryotic microbes but also in mammals and plants. He received the Normann Medal from the German Fat Science Society in 1987 on this subject.

(3) Immobilization of biocatalysts and its application.

At first, coenzyme B₆ bound to polysaccharide supports was used as a ligand to immobilize coenzyme B₆-dependent enzymes. This system was applied to the fundamental studies of the interaction of the coenzyme with the enzymes, and also analysis and production of various amino acids. Coenzyme B₁₂ was also used as a ligand in a similar manner. Thereafter, he developed new methods to entrap biocatalysts

by using photo-crosslinkable resin prepolymers and urethane resin prepolymers of different properties, both of which were polymerized to form gels under mild conditions. Physico-chemical properties of the formed gels entrapping biocatalysts could be changed optionally by selecting a proper prepolymer and the systematic studies on the effects of hydrophilicity–hydrophobicity balance, ionic properties, and net-work size of the gels enabled us to perform a variety of bioreactions efficiently. In particular, the bioreactions in organic solvents with hydrophobic gel-entrapped biocatalysts were one of his pioneering works. Engineering Foundation in USA gave him the Enzyme Engineering Award in 1989.

This special issue of the Journal of Molecular Catalysis B: Enzymatic is dedicated to late Professor Saburo Fukui. It consists of 36 papers on fundamental and applied studies on enzymes, contributed by his friends and former students to express their appreciation of him. The contents cover a wide range of the research fields, reflecting his wide interest in science and technology.

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