

Duke of Edinburgh Prize:

Kazuo KOMAGATA
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for “Studies on Microbial Taxonomy and
Development of Microbial Culture Collec-
tions”



Outline of the work:

Microorganisms are creatures that are invisible to the naked eye and include organisms such as moulds, yeasts, bacteria, archaea, and viruses. Since ancient times, humans have utilized certain beneficial microorganisms for brewing alcoholic beverages and making bread. However, some microorganisms are virulent pathogens for humans. We are now just beginning to realize the full potential of the relationships between humans and microorganisms and how their vast and diverse powers can be harnessed for improving our lives, including protection of the global environment.

Dr. Kazuo Komagata has studied such diverse microorganisms for six decades from the taxonomical perspective and remains active in introducing and developing new techniques and knowledge to promote this field. His outstanding achievements are highlighted by his studies of a group of the Gram-negative bacteria, which decompose artificial environment-polluting organic compounds, and a group of actinobacteria, formerly called “coryneform” bacteria, including those that produce industrially important amino acids.

In addition, Dr. Komagata has contributed to establishing and developing several key stations for microbial culture collections in Japan that preserve and supply reference strains and have important roles for both, fundamental sciences and industrial utilization of microorganisms. He has also played an important role as an executive board member of the World Federation for Culture Collections to assist its international activities for conservation and sustainable utilization of microbial resources in the world.

Therefore, it is now time that Dr. Komagata’s foresight and valuable studies are further recognized and acknowledged.

1. Contributions to Microbial Taxonomy

Dr. Komagata initiated his studies on bacterial taxonomy during the early 1950s for a group of the genus *Pseudomonas*, which are bacteria that can oxidatively decompose the aromatic compounds that are used as precursors for penicillin production. This group of bacteria inhabits a broad range of soils and aqueous environments and is characterized by versatile capabilities to decompose various organic pollutants, which are applicable to environmental restoration. However, at that time, the taxonomy of this group was confusing because it included pathogens for humans, animals, and plants that were studied separately in the fields of clinical bacteriology and plant pathology, which provided different perspectives depending on their positions. Dr. Komagata introduced objective analyses based on polyphasic taxonomy, which systematically evaluates various phenotypic characteristics, and successfully resolved the confusion through taxonomically rearranging the species in this genus.

L-Glutamic acid is an amino acid for UMAMI or flavor enhancer, which is traditionally used in Japan, had been commercially produced by hydrolyzing wheat gluten with hydrochloric acid. In 1956, a new bacterium

was discovered that accumulated large amounts of L-glutamic acid into its culture medium. The epoch-making discovery of this bacterium, considered as one of the greatest inventions in Japanese biotechnology, led to dramatic changes and new developments in the amino acid industry. Since then, L-glutamic acid and several nutritionally important amino acids have been produced by fermentation processes. This bacterium was classified as a new species: *Corynebacterium glutamicum*.

During the course of its development, however, a number of closely related bacteria were isolated from natural sources, and for which discrimination was difficult. More importantly, the genus *Corynebacterium* was not taxonomically well defined, and numerous associated species and even genera remained simply designated as “coryneform bacteria.” Dr. Komagata’s challenge was to resolve this problem by introducing several new methods, particularly chemotaxonomy, to place these bacteria in their correct positions in the taxonomic system.

At that time, chemotaxonomy was a new approach that enabled objective evaluations of phenotypes based on chemical analyses of cellular components. Cell-wall amino acids, cellular fatty acid profiles, and respiratory quinone systems were revealed as useful criteria for the “coryneform bacteria.” As a result, Dr. Komagata successfully established a rational taxonomic system for this large group of bacteria, which was later supported by DNA-based phylogeny, and therefore confirmed Dr. Komagata’s foresight.

In addition, Dr. Komagata has been instrumental in furthering the taxonomic studies of many other microorganisms, such as acetic acid and lactic acid bacteria used in fermented foods, the epiphytic yeasts of rice grains, and bacteria isolated from deep petroleum wells, along with isolating a number of new species, and therefore contributed to microbial ecology.

These achievements of Dr. Komagata on a systematic approach for microbial taxonomy, including the descriptions of new species and proposing a new taxonomic system, were highly recognized internationally when he was awarded the Van Niel International Prize by the International Union of Microbiological Societies in 1999 and the Bergey Medal by Bergey’s Manual Trust (USA) in 2005.

2. Contributions to Microbial Culture Collections in Japan and an International Network

Dr. Komagata’s work on microbial culture collections began at the Institute of Applied Microbiology of the University of Tokyo, which was established in 1954 as one of the earliest public microbial culture collections in Japan. This collection was in charge of collecting, preserving, identifying, and distributing microorganisms as references for research by the microbiology community and played a pioneering role for developing a system for microbial resource preservation.

In 1981, Dr. Komagata was appointed as the first director of the Japan Collection of Microorganisms (JCM), which had been established at RIKEN, one of the largest research institutions in Japan. He constructed this collection by specifically focusing on the taxonomic type strains of bacteria, which has evolved to become the world’s number two collection for depositing type strains for newly proposed species among prokaryotes. In the same year, Dr. Komagata was elected president of the Japan Federation for Culture Collections and made efforts to strengthen the culture collection network in Japan and enhanced its international status.

Dr. Komagata was also elected as an executive board member of the World Federation for Culture Collections (WFCC) in 1981, which at that time held more than 500 member culture collections in the world. As a board member, he oversaw the relocation of the activities of the World Data Centre for Microorganisms of the WFCC to RIKEN, where he increased the database of microbial resources held by the member collections and established a world-wide network to connect these. WFCC awarded honorary life membership to Dr. Komagata for his long, valuable service to the many activities of WFCC. Furthermore, Dr. Komagata was appointed as chairman of the OECD Workshop “Scientific and Technological Infrastructure—Support for

Biological Resource Centers (BRCs)” held in Tokyo in 1999. Its recommendation resulted in inaugurating a new culture collection, NBRC (Biological Resource Center, the National Institute of Technology and Evaluation), in Japan. The NBRC has become one of the top two general microbial culture collections in Japan along with the JCM.

In addition to these activities, Dr. Komagata has shared his experience and knowledge through lectures on microbial taxonomy and on culture collections for many years, for example, at the United Nations Educational, Scientific, and Cultural Organization (UNESCO) International Post-graduate University Course on Microbiology. He has also made significant contributions to capacity building in developing countries.

In conclusion, Dr. Komagata’s life-long achievements in the two inseparable fields of microbial taxonomy and culture collections played a pioneering role to establish the system for preservation and utilization of microbial resource. He has made significant contributions to the international scientific community and in improving the social understanding, implications, and significance of the earth’s microbial diversity.

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