THE IMPORTANCE OF MICROBIAL CULTURE COLLECTIONS AND GENE BANKS IN BIOTECHNOLOGY

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Summary

Biological resource centers play a crucial role in the conservation and sustainable use of microbial, animal and plant genetic resources for various applications. This paper deals with the current world status of culture collections and gene banks, their functions and activities, the services they provide which are of relevance to biotechnology and the future programs that biological resource centers may consider to further enhance and strengthen their capability.

1. Introduction

Culture collections and gene banks are at the very heart of efforts to conserve biological diversity. Their primary aim is to preserve their strain holdings while providing pure cultures and genetic materials required for biotechnology applications, teaching, research and other purposes, since their major task is to collect, preserve and make microbial strains accessible to the public.

Some culture collections also offer microbiological services to academic institutions and industry, and conduct studies related to systematics, thus contributing to the wealth of knowledge and leading to the discovery of new taxa. Culture collections and gene banks therefore play a significant role, not only in the development of biotechnology-based

industries and in education, but more importantly, in the conservation of microbial strains which constitute part of a country's heritage.

2. Microbial Resources

Micro-organisms have long been recognized as vital components of the world's biodiversity. They are involved in nutrient recycling (e.g., breaking down complex plant and animal remains), beneficial mutualistic relationships (e.g., nitrogen fixation, animal digestion, mycorrhiza), and in the production of the bulk of atmospheric oxygen. Moreover, they are pathogens of pests and disease-causing organisms, hence may be harnessed by man for the biological control of pests in integrated pest management programs.

Their other uses include production of natural products (e.g., valuable drugs, enzymes, metabolites) for pharmaceutical, food and other applications, composting, bioremediation and detoxification of wastes. They play a major role in soil fertility and plant and animal health and are employed in diagnostics, efficacy testing of drugs, biocides, disinfectants or as reference strains. This versatility in function has brought micro-organisms to the fore, turning them into key players in the dawning of the biotechnology era during the latter part of the 20th century.

Despite their importance, however, conservation of microbial strains has not been given much attention in the past. Astronomical numbers of micro-organisms have been isolated from natural populations since the time of Pasteur, yet only a small fraction has been preserved and a large number have been left unattended and lost, after a project has been terminated or after the microbiologist has changed interest. The loss of microbial cultures has, in the past, been attributed mainly to the lack of adequate permanent and reliable repositories.

More and more culture collections are becoming endangered, and a significant number have been lost, resulting in a situation where the few that remain are woefully inadequate to conserve the world's microbial resources. For example, for the fungi alone, Hawksworth estimated that in 1991, there were 1.5 million species in the world, 72 000 of which have been described, yet less than 1 percent (11 500) are held in culture collections worldwide. The number continues to rise, and unless there is a more directed effort to conserve these new strains, the tragic loss of these irreplaceable resources will go on unabated. Thus, activities like isolation and screening programs need to be coupled with accurate identification, proper documentation and conservation efforts.

It is in this context that a global initiative towards conservation of biological resources was established during the Earth Summit in Rio de Janeiro in 1992. During that meeting, the Convention on Biological Diversity (CBD) was drafted and as of today, over 160 countries have ratified the Convention. All signatory-countries have drafted their own national agenda to reaffirm their commitment to the conservation of their national biological resources.

The aim is to secure the genetic pool as a resource for the continued search for novel products that may find application in medicine, nutrition, agriculture, etc. As

biotechnology industries develop, micro-organisms are also being discovered which, due to forces of selection and the limitations imposed by isolation methods, these newly discovered micro-organisms might not be re-isolated in the future. Therefore, every effort must be made to adequately preserve these isolates in order to maintain their integrity, for future use in screening, genetic improvement, characterization, and sustainable production of desirable end-products.

2.1. Establishment of Culture Collections

While several publications on techniques, procedures and a few guidelines have been published for the establishment of culture collections, no internationally approved set of guidelines covering all aspects of culture collection activity had been compiled until the World Federation for Culture Collections (WFCC) prepared such a document in 1991. A second edition of this document was published in June 1999.

These guidelines were prepared to provide assistance to those culture collections offering services outside of their own institution. The WFCC hoped that the guidelines will be adopted by service collections as best they could. The WFCC Guidelines for the Establishment and Operation of Collections of Cultures of Microorganisms focus on the following aspects: organization, funding, objectives (short-term and long-term), the kind and number of strains to be maintained, staff, services, safety and quality standards.

Furthermore, as centers of expertise, research programs should be a part of every culture collection's activity. Formal or informal linkages with other culture collections should be established and maintained for exchange of information and discussions of mutual problems. Collections are encouraged to join the WFCC and register with the World Data Center on Microorganisms (WDCM).

2.2. Kinds of Culture Collections

Culture collections may be classified into three categories based on their specialties and functions:

- Private culture collection - Usually maintained by individuals, laboratories, institutes, hospitals and commercial firms. The number of holdings may range from small to large. Some collections are comparable to a public collection. For example, research institutes in some private companies hold more than 20 000 cultures. The strains in private culture collections are usually not open to the public.
- Specialized collection - More often arises in the course of a taxonomic study on a specific group of micro-organisms in specialized fields such as brewing, production of antibiotics, plant pathology, and others, when a considerable number of strains have been isolated. An example of this type of collection is the mushroom collection being maintained by the Fungal Collection of Micro-organisms of the University of the Philippines, Los Banos (FCUP, WDCM 103).
- Public collection - Consists of a large number of strains, and is established for the purpose of public service. The number of taxa varies from collection to collection. For example, the Centraalbureau voor Schimmelcultures (CBS) (www.cbs.knaw.nl) in the Netherlands maintains over 8 000 species consisting of 18 000 strains of fungi

while the National Research Institute of Brewing (www.nrib.go.jp) in Japan has approximately 900 mold strains (as of 1992), although the taxa are rather limited to *Aspergillus* species.

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Biographical Sketch

Lourdes M. Mahilum-Tapay was born in the Philippines in 1958. She took up her bachelor's and master's degrees in biology and microbiology, respectively, at the University of the Philippine-Los Banos UPLB. For her theses, she worked on the characterization and identification of yeasts associated with coconut and nipa saps. She took her first job in 1979, as a research assistant at the Microbial Culture Collection Section of the Museum of Natural History, UPLB, and then moved to the BIOTECH Microbial Culture Collection and Services Laboratory, also of UPLB, in 1981. Both culture collections were just being started. She undertook training in microbial identification and culture collection management techniques locally and abroad. She was appointed as head of the laboratory in 1985, and in 1987, she participated in UNESCO's one-year International Post-Graduate Course in Microbiology at Osaka University and the University of Tokyo. She worked on the identification of free-living, nitrogen-fixing bacteria under Prof. K. Komagata. She earned her PhD in Microbiology from the University of Hawaii in

1996 after completing her dissertation on shrimp cell culture and viruses. Upon returning to UPLB, she has been teaching virology and has taken students under her mentorship. Dr. Tapay has spent all of the 21 years of her professional life in culture collection work, and has been instrumental in setting up the Philippine Network of Microbial Culture Collections. Her interests include microbial systematics, culture collection management, and the development of diagnostic protocols for infectious diseases.