

MICROBIOLOGICAL RESOURCES CENTRE (MIRCEN) AT THE CHINESE UNIVERSITY OF HONG KONG, SHATIN, HONG KONG (1991-2003)

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Summary

The Hong Kong Microbial Resources Centre was officially inaugurated in June 1991 at the Chinese University of Hong Kong. The main theme of the newly established MIRCEN was identified as Bioconversion Technology, and its activities are described under the three headings: Research, Training, and International Services. The major research activities have been focused on the bioconversion of waste materials to food and useful products by edible/medicinal fungi, and on the development of fungal-based bioremediation processes for environmental improvement. The Hong Kong MIRCEN has also played a major role in the training of young scientists, especially those from developing countries. Visiting trainees have included young researchers from Ghana, Brazil, People's Republic of China, Cambodia and Colombia. It has also provided an in-house training course in bioconversion technology and advanced mushroom biotechnology for resource centre managers in Asia and Africa. The course included lectures and practical sessions on the physiology and biochemistry of selected mushroom fungi in relation to growth and substrate utilisation. Senior personnel associated with the Centre have engaged in numerous international consultancy activities related to its primary focus including several programmes in sub-Saharan Africa supported by various international agencies and foundations. Through its access

to a mushroom germplasm depository, the Hong Kong MIRCEN has also provided mushroom cultures to universities, research institutions and companies in countries worldwide.

1. Introduction

The Hong Kong Microbial Resources Centre (MIRCEN) was officially inaugurated in June 1991, under the Directorship of Professor Shu-ting Chang, Chairman of the Department of Biology at the Chinese University of Hong Kong (CUHK). The main theme of this newly established MIRCEN was identified as Bioconversion Technology. Therefore, it was a natural progression for the Centre's headquarters to be based in a department where much of the research and training activity at the time was focused on the development of mushroom-based strategies for utilising lignocellulosic and other organic wastes, and on bioremediation systems. A close cooperation was subsequently developed between the Hong Kong MIRCEN and the Centre for International Services for Mushroom Biotechnology (CISMBiotech), established on the CUHK campus in October 1993 and sponsored jointly by the United Nations Industrial Development Organization (UNIDO) and CUHK. The activities of the two centres were highly compatible since CISMBiotech was part of UNIDO's programme for Strengthening and International Networking of Institutions in Developing Countries to Promote Mushroom Biotechnology and Bioconversion Technology for Sustainable Industrial Production and Processing. The main functions of CISMBiotech were

- (1) to serve as the centre of a global network to support mushroom- and bioconversion-based industries through the strengthening of key national organisations engaged in research and development related to mushroom and bioconversion technology, and
- (2) to provide technology transfer and services to organisations in developing countries through training courses, workshops and consultant activities.

The Hong Kong MIRCEN and CISMBiotech shared access to

- (i) fungal growth and maintenance equipment including liquid nitrogen storage facilities, refrigerator/freezers and incubators, and a sophisticated high performance liquid chromatography (HPLC) system,
- (ii) a computerised database, and
- (iii) a mushroom genebank and culture collection.

The computerised database included listings of institutions and research groups actively engaged in bioconversion research, details of research programmes in progress, and abstracts of publications emanating from these sources. The database was designed to have unique features relevant to the needs of the targeted end-users and aimed to avoid duplication of other systems. For the purpose of this article, details of the Hong Kong MIRCEN's activities are described under the three headings: Research, Training, and International Services.

2. Research

A major area of research interest at the Hong Kong MIRCEN is the bioconversion of waste materials to food and useful products by edible/medicinal fungi. Edible

mushrooms are a source of high quality protein which can be produced with greater biological efficiency than animal protein and thereby have important potential in less developed countries for enriching the diet of populations suffering from protein deficiency. Mushrooms also have high vitamin, high fibre and low fat contents, good flavour qualities and recognized tonic properties. Production is particularly applicable to situations where large-scale capital intensive operations are inappropriate, and harvesting and post-harvest processing requirements are minimal. Perhaps the most compelling consideration is that mushrooms can be cultivated on a wide variety of inexpensive substrates/wastes including such diverse materials as cereal straws, bagasse, banana leaves, coffee grounds, sawdust and cotton wastes from textile factories. This is extremely important in rural areas where there are often available large quantities of agricultural wastes ideally suited for growing different types of edible mushrooms. Of further value is the spent substrate residue left after mushroom harvesting which can be used as an animal feedstock and/or a soil conditioner. Furthermore, with the growing realization that edible mushrooms represent a source of high value metabolites (e.g. anti-tumour and immunopotentiating agents, hypocholesterolemic compounds, flavourants), they also hold considerable potential as a future cash crop.

There has been consistent compatibility between the main focus of the Hong Kong MIRCEN and edible/medicinal mushroom-related research projects undertaken in the Department of Biology at CUHK. The latter have included:

- (i) the selection of new hybrids of non-agaric edible mushrooms with improved organoleptic qualities, higher fruiting yields, etc., using breeding programmes based on protoplast fusion techniques;
- (ii) development and application of molecular biological techniques for use in strain characterization/typing, confirmation of a protoplast fusion products, identification of species-specific DNA markers, establishing monokaryon-dikaryon relationships, demonstration of dikaryotization and the generation of polymorphic molecular markers which may be used as genetic markers in progeny analysis,
- (iii) biochemical analysis of mushroom enzymes important for lignocellulose breakdown for the development of targeted strategies for strain selection and improvement aimed at increasing the efficiency of substrate bioconversion into fungal mycelium and fruit bodies;
- (iv) production of high value metabolites by non-agaric edible mushrooms;
- (v) the screening of natural populations of Chinese strains of *Lentinula edodes*,
- (vi) the biochemical changes associated with the post-harvest deterioration of *V. volvacea* fruit bodies;
- (vii) molecular studies on the genes encoding lignocellulases and their possible role in fruiting; and (viii) studies on mushroom-derived antioxidants, DNA-damage protection agents and DNA-repair stimulating agents.

Other fungal-related research projects have been directed at developing bioconversion/bioremediation processes for the removal of dyes from industrial waste water. Dyeing works and textile plants located in Southeast Asia and elsewhere generate a variety of highly coloured industrial waste effluents. Lignin-degrading white-rot fungi possess

non-specific enzyme systems capable of degrading a large number of compounds with widely different chemical structures. These enzymes degrade not only dyes but many other recalcitrant environmental pollutants including polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs) and dioxins, and represent potential bioconversion systems for the general detoxification of hazardous chemical wastes.

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Biographical Sketches

Professor Shu-Ting Chang, Emeritus Professor of Biology, The Chinese University of Hong Kong, is a past Vice-President of the World Society for Mushroom Biology and Mushroom Science; and Director of Hong Kong MIRCEN for Mushroom Science, which is sponsored by UNESCO. He is also the Director of the Centre for International Services to Mushroom Biotechnology under the aegis of UNIDO, and an Editor of the International Journal of Medicinal Mushrooms.

Professor Chang received a BS degree from the National Taiwan University in 1953 and earned MS and PhD degrees in 1958 and 1960 respectively from the University of Wisconsin. He was awarded a post-doctoral fellow at Harvard University during 1966-67, a Visiting Fellow at the University of Tokyo in 1969 and at the same time a Visiting Fellow of the Australian National University (ANU) and the CSIRO during 1972-73 and 1978-79. Other Honours include:

- Elected Fellow of the World Academy of Art and Science (1989)
- Fellow of the International Institute of Biotechnology (1990)
- Fellow of the World Academy of Productivity Science (1992)
- International Cooperation Award for Light Industry, China (1990)
- Honorary Life Member of the British Mycological Society (1990)
- Honorary Life Member of the International Society for Mushroom Science (1993)
- An Officer of the Most Excellent Order of the British Empire (OBE) in 1994

Prof. Chang has authored or co-authored 185 articles in scientific journals and 16 books.

Professor Chang and his family have moved to Canberra (Australia) after his retirement in 1995.

John Buswell received a B.Sc and Ph.D degree from the University of Birmingham, England, in 1963 and 1966, respectively. In 1966/7, he was awarded a Rosalie B. Hite Postdoctoral Fellowship from the University of Texas at Austin. He later took up an Assistant Professorship in the Department of Microbiology, University of Southwestern Louisiana, before returning to the UK as a Science Research Council Postdoctoral Fellow, at the Biological Laboratories, University of Kent. From 1972-89, he was a Lecturer/Senior Lecturer in the Department of Biology, Paisley College of Technology, Paisley, Scotland. From 1990-2003, he was a Lecturer/Senior Lecturer/Reader in the Department of Biology, The Chinese University of Hong Kong before moving to his present position as Guest Professor, Institute of Edible Fungi, Shanghai Academy of Agricultural Sciences. He has also worked as a visiting researcher at the Swedish Forest Products Laboratory in Stockholm (1978-80), the Institut National Agronomique in Paris (1984/5), and the University of Georgia in Athens, USA (1989-90). Other positions held have included: Co-Director, Hong Kong MIRCEN; Hong Kong Representative & General Secretary, International Mycological Association Committee for Asia; Deputy Director, UNIDO-Chinese University of Hong Kong Centre for International Services to Mushroom Biotechnology; Secretary/Treasurer, World Society for Mushroom Biology and Mushroom Products; Committee and Founding Member, Mycological Association of Hong Kong; and a member of the Editorial Boards of the Journal of General Microbiology, World Journal of Microbiology and Biotechnology, Letters in Applied Microbiology, and Acta Edulis Fungi. He has authored/co-authored over 80 articles in scientific journals and co-edited 2 books.