*Gazi University Journal of Science*
*GU J Sci*
*24(2):175-180 (2011)*

GUJS
*www.gujs.org*

# Microbial Culture Collections: The Essential Resources for Life

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*Received: 18.12.2009 Accepted:17.05.2010*

**ABSTRACT**
Microbial culture collections are crucial resource centres providing microbial materials. They act as repositories for microbial strains as part of patent deposits, confidential services to store key organisms for research, industry and society and sources of microorganisms cited in scientific papers that can be used in the confirmation of results and for further studies. Microbial culture collections are considered as libraries, but instead of books they hold microorganisms. The first culture collection was established by Prof. Frantisek Král in 1890 at the German University of Prague. After this collection, many culture collections established. Now there are 568 culture collections over the world. These collections categorize as national collections which provide extensive services or small collections which supply strains or related services by special agreement. Microorganisms provide many solutions to world problems in public health, food, environment and poverty and they are extremely important for various ecosystems.

**Key Words:** Microbial Culture Collection, Frantisek Král, Microorganism.

## 1. INTRODUCTION

Microbial culture collections have existed since bacteriologists were first able to isolate and cultivate microorganisms and have been an essential aspect of microbiology [1]. They supply a rich source of microorganisms that are of past, present and potential future interest [6]. They are usually considered to be a means to preserve microorganisms ex situ [3].

This paper will (i) review the history of microbial culture collections, their types and roles (services), (ii) impress economic importance of microorganisms, (iii) compare diversity of culture collections and microorganisms in terms of countries with rich or poor diversity.

## 2. HISTORY AND TYPES OF MICROBIAL CULTURE COLLECTIONS

The first culture collection was established by Prof. Frantisek Král in 1890 at the German University of Prague (Czech Republic). Král (1846-1911) worked for about 30 years for the glass manufacturing firm Venceslaw Batka; afterwards, he worked as a technician by the Institute of Hygiene of the German University of Prague. His experience with manufacturing laboratory glass products was the reason he was subsequently chosen as director of the bacterial collection by Prof. Soyka. Then because of his experience isolating, cultivating and maintaining microorganisms, he was appointed to associate Professor of Bacteriology. In 1900, Král published the first catalogue of microorganisms from a culture collection [3]. After the death of him, in 1911, this collection was acquired by Professor Ernst Pribham who transferred it to the University of Vienna and issued several catalogues listing the holdings of the collection. Part of this collection was brought to Loyola University in Chicago by Prof. Pribham in the 1930s. Many of this collection's cultures were subsequently transferred to the American Type Culture Collection (ATCC) after Pribham's death, but others remained in the collection at Loyola University. The Vienna portion of the Pribham Collection was largely lost during World War II [1]. After Král's collection, many culture collections were established. Currently, the oldest working collections are the Mycothèque de l'Universitée Catholique de Louvain (MUCL) established in 1894, in Louvain-la-Neuve, Belgium, and the Collection of the Centraalbureau voor Schimmelcultures (CBS) founded in 1906, in Utrecht, the Netherlands [3]. Now there are

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568 culture collections in 68 countries registered in World Data Center for Microorganisms (WDCM) over the world [7]. Most of these collections are small, specialized collections that supply cultures or other related services only by special agreement. Others, particularly national collections, publish catalogues listing the organisms held and provide extensive services for industrial and academic organizations (Table 1) [6].

Table 1. Some Microbial Culture Collections in the World.

| *Acronym* | *Name of Collection* | *Country* | *Type of Agency* |
|---|---|---|---|
| ATCC | American Type Culture Collection | USA | Governmental, Semi-governmental, Private, University, Industry |
| DSMZ | Deutsche Sammlung von Mikroorganismen und Zellkulturen GmbH | Germany | Governmental |
| NCYC | National Collection of Yeast Cultures | UK | Governmental |
| LMG | Belgian Coordinated Collections of Microorganisms/LMG Bacteria Collection | Belgium | Semi-governmental |
| RSKK | Refik Saydam National Type Culture Collection | Turkey | Governmental |
| NBRC | NITE Biological Resource Center | Japan | Semi-governmental |
| VKM | All-Russian Collection of Microorganism | Russia | Governmental |
| CIPDE | Collection of Insect Pathogens | India | University |
| CBS | Centraalbureau voor Schimmelcultures, Fungal and Yeast Collection | Netherlands | Semi-governmental |
| SCCM | Sporometrics Culture Collection of Microorganisms | Canada | Industry |

## 3. SERVICES OF MICROBIAL CULTURE COLLECTIONS

Why are microbial culture collections vital for life? What are their primary roles? Why should governments, industries, private sectors and universities care about them? The answers of these questions lie behind the roles played by microbial culture collections: (i) to collect, maintain and dispatch microbial cultures, (ii) to collect culture data and make them accessible to the microbiological research community via printed or online catalogues. Data of cultures are usually as valuable as the organism itself, and researchers need to access to this information. Advanced databases are crucial to this knowledge transfer. Researchers and taxonomists can select the strains for a particular research application through printed catalogues or online databases. These data, notably in the age of bioinformatics, will become even more precious, (iii) to act as safely deposits of microorganisms with restricted distribution, (iv) to provide identification services according to the expertise of the culture collection about different kinds of microorganisms, (v) to serve as repositories for valuable cultures. It is important to deposit cultures described in publications to ensure future access and allow for scientific reproducibility. For instance, most journals today require the deposit of sequences in public repositories, and it should also be obligatory to deposit the cultures from which the sequences are derived, (vi) to organize training courses and workshops, notably related to the identification and maintenance of microorganisms. Short courses and workshops are essential to train personnel from medical, environmental, industry or government laboratories who have responsibilities for isolating and identifying microorganisms, diagnosing disease, quality control, fermentation, culture management, etc., (vii) to carry out research related mainly to taxonomy and microbiological preservation, (viii) to provide general advice in the field of microbiology [2, 3].

## 4. IMPORTANCE OF MICROORGANISMS

Microorganisms – prokaryotes, viruses, viroids, filamentous fungi, yeast, microalgae and protozoans – comprise the greatest numbers of organisms on Earth. And they are ubiquitous creatures of the Earth [37], occurring in a wide range of environments that have physico-chemical conditions close to the limit values in which an organism can live [38] such as hydrothermal vents (deep-sea smokers) [39] and hot springs [40], acid mine drainages and rivers [41], in gypsum halite crusts and in NaCl crystals [42], in polar regions [43] and even in nuclear reactors [44].

Microbial biotechnology requires the existence of microbial culture collections since microorganisms maintained in them provide biomolecules as well as sources of compounds with a wide variety of research and industrial applications (Table 2) [5]. Microorganisms are important for us for many reasons, but one of the principles ones is that they have been produced products of value to us in the each phases of biotechnology such as production of bread, beer, wine in ancient times, production of secondary metabolites such as antibiotics, bioinsecticides, ergot alkaloids and fermentation of acetone and glycerol in World War I and production of microbial products with recombinant DNA technology with began third phase of biotechnology [11]. For instance, It was reported the expression of thermostable alkaline protease gene from *Thermoactinomyces sp.* E79 in *E. coli* and heat activation of the gene product [45]. In addition to these industrial applications, microorganisms have a crucial role in ecosystems, breaking down animal carcass' and plant remains in soil, forming beneficial mutualistic relationships with various plants [4]. Microorganisms also include agents that lead to disease, in some cases, maintaining ecological balance. Gold suggested that there are no sites on Globe that have been free of microbial infection for long periods of geologic time [37].

Table 2. Examples of Some Products from Microorganisms.

| **Industrial Products** | **Microorganisms** | **References** |
|---|---|---|
| Bread, beer and wine | Generally *Saccharomyces cerevisiae* | [22] |
| Dairy Products | Lactic acid bacteria | [15] |
| Soy sauce | *Zygosaccharomyces rouxii* | [32] |
| Protease | *Geobacillus* sp. YMTC 1049 | [31] |
| Lipase | *Bacillus* Strain A30-1 ATCC 53841 | [36] |
| Amylase | *Clostridium thermosulfurogenes* SV2 | [17] |
| Acetone | *Clostridium aurantibutyricum* ATCC 17777 | [12] |
| Bioinsecticide | *Bacillus thuringiensis* | [14] |
| Silage | Lactic acid bacteria | [16] |
| Ergotamine | *Claviceps purpurea* | [34] |
| Interferon | *Escherichia coli* | [27] |
| Insulin | Recombinant *Escherichia coli* | [19] |
| Penicillin | *Penicillium* strains | [25] |
| Streptomycin | *Streptomyces griseus* | [30] |
| Nisin | *Lactococcus lactis* W8 | [28] |
| Bacitracin | *Bacillus licheniformis* | [26] |
| $B_{12}$ | *Pseudomonas denitrificans* | [20] |
| Ascorbic acid | *Acetobacter* strains | [33] |
| Riboflavin | Recombinant *Bacillus subtilis* | [21] |
| β-carotene | *Blakeslea trispora* | [24] |
| Alginate | *Azotobacter vinelandii* | [13] |
| Cellulose | *Acetobacter xylinum* NBRC 13693 | [35] |
| Polyhydroxybutyrate | *Ralstonia eutropha* | [18] |
| Pullulan | *Aureobasidium pullulans* HP-2001 | [29] |
| Single cell protein | *Candida utilis* | [23] |

## 5. DIVERSITY OF CULTURE COLLECTIONS AND MICROORGANISMS

While most countries such as classified as megadiverse countries host 60-70% of the planet's biodiversity, many of the collections and microorganisms hold in collections lie outside of these countries. As an example, Europe has a lower presence of biodiversity relative to other continents because of its small size, its distance from tropics and mountain ranges of the Alps and Pyrenees parallel to the equator that posed a barrier to species migration [9]. However, European Countries hold 33% of the culture collections and 41% of microorganisms.

Colombia is one of the 17 countries of megadiversity, but little is known about microorganisms. Colombia has 2 culture collections holding 4,092 cultures. Similarly, China has a huge biodiversity because of a vast territory of complex climates and very diverse geography with tropical forests holding 25% of country's species. China is also one of the largest agricultural countries of the world with more than 30,000 flowering plants, 30 species of grain, 200 types of vegetables and 300 types of fruit trees. In addition to this biodiversity, microbial diversity includes 30,000 fungi and 16,000 bacteria. However, according to Hawksworth's [10] formula for the 30,000

flowering plants, there must be possibly 180,000 fungi [4]. At present, there are 22 culture collections registered with WDCM with 46,000 strains of bacteria and fungi [8]. Table 3 shows registered culture collections over the world in point of continental distribution.

Table 3. Distribution of Registered Culture Collections in the World.

| Continents | Collections | Cultures | Ratio collections:cultures |
|---|---|---|---|
| Africa | 11 | 12,255 | 1:1114 |
| Asia | 191 | 359,067 | 1:1879 |
| Europe | 189 | 632,566 | 1:3347 |
| America | 134 | 440,726 | 1:3289 |
| Oceania | 43 | 89,786 | 1:2088 |

## 6. CONCLUSION

Microbial culture collections have a crucial role to play in the maintaining, understanding and utilization of microbial diversities. Microorganisms in these diversities are the major part of industrial biotechnology. This review provides some examples to show importance of microbial culture collections and links between microorganisms and industrial products which are important in our life.

## ACKNOWLEDGEMENTS

The authors thank David L. Hawksworth and Ömür Gençay for providing some articles used in this review.

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