

The 14th Resource Committee of Microbial Materials
Evaluation and Suggestions

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Division/Team Name: Microbe Division (Japan Collection of Microorganisms-JCM)

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1. Achievements and plans for the Division

(1) Have the current achievements reached the standards of those made by the major international bioresource centers?

- Based on the numbers of microbes collected and preserved, maintenance of type strains, numbers of distribution and users, the Division is reaching the international standards. Quality control, the wide range of various strains, and their contribution to Asian microbiology research are all of a high standard. Moreover, the Division is highly evaluated for undertaking major efforts rescuing for resource collections whose continuation is threatened. In particular, the Division's contribution to Asian microbiology studies should be noted. There are no problems in terms of improving added value of resources and compiling information.
- The Division is the world's second-largest in total number of type strains, and third in the annual number of deposition. Of the deposits, 75% comes from overseas, while 33% of distributing resources goes overseas. It is evident that the Division has reached standards of major bioresource centers of the world.
- The Division has been certified and maintained the ISO9001:2015 international standard quality management system and have reached global standards in terms of quality control.
- Between 2013 and 2017, resources distributed from the Division have contributed to the publication of 2,855 scientific papers as well as to 480 patents by the users.
- Every year the members of the Division have published over 30 scientific papers of their own.

(2) Have sufficient achievements been made for contributing to society and to the research community within Japan and overseas?

- The Division has made achievements contributing to the research community, which is clearly shown by the numbers of publications and patents, and commercialization outcomes, by the users. In addition, the publications of research results by the JCM members are commendable.
- Research papers using JCM strains and articles describing deposited strains with the JCM numbers have been published in leading scientific journals such as *Nature*. By responding to

research needs, and by leading cutting-edge research, the Division is making a large contribution to scientific research.

- As JCM strains have been used in many public patents and some of them have led to commercialized products, JCM has greatly improved not only technical development and innovation, but also people's lives and welfare.
- The following activities have created a positive spiral which contributes greatly to microbiology research in Asia: 1) deposits made by researchers from various Asian countries, 2) publication of deposited strains, 3) supplying resources to researchers in various Asian countries, and 4) the publication of research results using supplied strains.
- The Division is becoming an increasingly important microbial resource center for researchers, both within Japan and overseas. JCM has rescued valuable endangered microbial resources from other institutions both in Japan and worldwide.
- The Division is working on characterizations of holding strains, development of genome information, enrichment of the catalogue database, and raising value added in order to respond to the needs of users.
- Annual technical training courses have been carried out on the handling of microbial resources. Also noteworthy are the public relations activities in academic societies.

(3) Are current activities and plans based on the results of the 3rd Mid- to Long-Term Plan or the achievements in the previous position? Are they in line with the BRC's 4th Mid- to Long-Term Plan (7 years from 2018 to 2024)? Are they appropriate and do they contribute to the development of the center?

- The major objectives to be achieved are based on performance during the last plan and are both appropriate and in line with the BRC's 4th Mid- to Long-Term Plan. In particular, the focus on the microbial collection of symbionts of plants and animals, and that relating to bioenergy and metal corrosion, is appropriate. It is expected that research in environmental and health sciences will accelerate.
- The Division plans to supply resources and services which are both sought after by multiple research fields, and in high demand from both basic and applied fields such as taxonomy based on genome sequence and health-related research. The Division's contribution in these areas help the center's development.
- The 4th Mid- to Long-Term Plan includes challenging R&D in addition to appropriate research plans. Besides the cross-centers all-RIKEN program, the Division is also acquiring external funds and participating in international projects. These efforts will steadily advance the plan and will have substantial impacts on the center's development.

- Regarding its international hub function, international collaboration has been performed to analyze genome information for “type strains” of prokaryotes. This collaboration is commendable.
- They are also making leading efforts, such as introducing mass spectrometry to improve quality control.

(4) What are resources to be developed and research/ technological development to be undertaken in addition to those currently planned in the initial 4th Mid- to Long-Term Plan?

- Expansion of their resource lineup to meet the various needs of society and research is an important initiative. Additionally, to improve convenience for users, it would be helpful to examine means enabling simple access to target resources in the catalogue database.
- Regarding the analysis of genome information for type strains, their participation in international projects has been appropriate, and this is expected to make a significant contribution.
- Classification of microorganisms is transitioning to genome sequence-based taxonomy faster than expected. It is necessary to support relevant researchers within Japan and overseas, and to develop infrastructure for the support.
- The Division has participated in the international project for analyzing genome information of prokaryotic “type strains” at the World Data Center of Microorganisms (WDCM). However, under the Convention on Biological Diversity, arguments have arisen insisting that not only genetic resources, but also sequence information, should be targets for access and benefit sharing. The Division ought to pay attention to the argument.
- Research plans focusing on difficult-to-culture or yet-uncultured microorganisms will lead to innovation through the application of microorganisms.
- Collection of difficult-to-culture microorganisms associated with animals such as humans and livestock, and those within plants and rhizospheres, should be prioritized from the perspectives of food, health, and environmental sciences.
- It is necessary to develop single-cell analysis platform that does not require culturing microorganisms. Of course, single-cell analysis technology entails the examination of single-cell genome. In addition, it is also important to develop technology for cellular evaluation, i.e., identification at genus and species levels as well as function using single-cell imaging.

2. SWOT analysis

(1) Are the results of the presented SWOT analysis valid?

- These are reasonable.

(2) Are the countermeasures for the results of the SWOT analysis appropriate?

- These are appropriate.
- The Division has already planned for collection of resources to meet needs. Positive results are expected.
- Collaboration with experts in genome analysis and informatics experts will be essential.
- In the next few years, staff who have been active in JCM for many years will retire. To construct a system for the next phase smoothly, efforts should be made to recruit and train young staff, to transmit techniques and knowledge to the next generation, and to resolve vertical splits of the JCM structure.
- The declining number of Japanese microbiologists may require responses and countermeasures. There seems to be a need not only to increase numbers of overseas users, but also for measures to prevent a decline in the number of Japanese researchers. For this, the Division should consider adopting measures by collaboration with relevant academic societies, while strengthening education and enlightenment activities.
- A countermeasure for the delays in the quality checks by gene sequencing of some microbial groups has been taken by the checks immediately prior to supply. However, it would seem beneficial to proceed with a certain number of checks each year for strains which are not asked for supplying.
- It would be good to self-assess the extent of their attainment, with specific examples of implementation and measures.

3. International collaboration

(1) Is the international collaboration being actively addressed, and is the Division functioning as a hub of international scientific technology?

- International collaboration has shown results without problems.
- The Division is participating in a number of international projects, such as establishing a WDCM global catalogue, determining genome sequence of type strains, and analyzing genome information of budding yeast. Researchers in JCM have become many of committee members of international organizations (including the World Federation for Culture Collections (WFCC));

clearly, they are functioning well as an international hub for science and technology.

- The acceptance of overseas researchers and publication of collaborative papers with these researchers are the evidence for JCM as an international hub.
- The Division has been actively taking on international exchange and collaboration, focusing on Asia in the Asian Network of Research Resource Centers (ANRRC), the Asian Consortium for the Conservation and Sustainable Use of Microbial Resources (ACM) etc. and has been demonstrating strong leadership.

4. PI assessment

(1) Is the PI fulfilling the role in line with the BRC mission?

- The PI is playing his role satisfactorily, in accordance with the BRC's mission, and continues to provide results in line with the BRC's 4th Mid- to Long-Term Plan. Aspects of this undertaking include the followings: 1) maintaining the world's top-level resources, 2) functioning as an international research hub, 3) contributing to broad research and development, spanning from basic to applied science, 4) implementing world-leading quality control and information dissemination, and 5) returning results to the research community and society.
- The catalogue database functions to provide a method enabling users to efficiently select the particular resources they require from a huge number of varying resources. However, its development may well be a topic for the future.

(2) Do the PI's achievements in research and development (R&D) satisfy international standards in light of the following three aspects? (i) Results output and impact, (ii) Contribution to specific missions of each laboratory regarding research support and collaborative exchange programs within RIKEN, (iii) Pioneering new fields of research, acquisition, and commercialization of intellectual property rights, social education for science, the fusion of different fields, and social contribution

- The PI's research and development achievements meet international standards:
 - (i): besides output, the PI is also having world-leading impact in numerous areas, including: 1) the number of microbial strains deposited and preserved, 2) quality control, 3) a large number of users' and of his own papers including cutting-edge research, 4) a large number of published patents by users, and 5) examples of commercialization.

- (ii): The PI is carrying out collaborative studies in many fields. For example, as sub-leader of the all-RIKEN cross-centers program symbiosis, the PI leads the program and is producing many excellent results. The PI serves various committee members and chiefs, while making efforts to support research.
 - (iii): Through metagenomes, integrated omics, single-cell analysis, and isolation and cultivation of microbes, efforts are being made to open up new fields of research. These attempts include the construction of research platforms for symbiosis through combination and upgrades of cutting-edge technologies held by RIKEN. Results and achievements are commendable, and include the followings: 1) patent applications spanning topics relating to environment and food, 2) authoring explanatory articles in books, 3) being elected as the next president of the Japan Society for Microbial Resources, 4) acquisition of intellectual property right, as well as 5) social enlightenment and contributions.
- (3) Is the PI appropriately tackling the management and operation of the Division? In addition, does the PI make efforts for training and development of young talent?
- The PI is working appropriately on team management and operations, and is making efforts to develop young talent.
 - Using the ISO9001 system, the PI is redeveloping the conventional laboratory system, wherein only one individual is in charge of a group of microbial strains. Instead, he is shifting to a group system consisting of multiple individuals, aiming for information sharing and the standardization of roles etc. The management and operation of the lab is being addressed appropriately.
 - The PI is training and instructing many postdoctoral researchers and graduate students. The promotion of laboratory staff is also emphasized, and the results of training a diverse range of young talent are highly valuable. Hiring postdoctoral researchers using competitive funds, thereby increasing the flow of trained successors, is an effective approach in securing superb talent.
 - From a long-term view point of increasing the number of microbiology researchers, it may be worth examining the possibility of the education of university graduate and undergraduate students by providing lectures and offering internships.

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