

Development and Use of Biotechnology and its Influence

– Problem on Practical Use of Biotechnology –

(NISTEP Report No. 13)

4th Policy-oriented Research Group

The 4th Policy-oriented Research Group has been conducting "Study on Development and Use of Biotechnology and its Influence" to find out problems in practical use of biotechnology which has large influence on utilization and creation of resources. The Group has recently written a report on the study. The following is an outline of the report.

1. Study Method

In designing and arranging the study, we established "Research Group on Development and Use of Biotechnology and Its Influence" (Chairperson: Shinzo Tsumura, Advisor, Taiyo Fishery Co. Taiyo Research Institute) with people of experience or academic standing as its members, and discussed design and arrangement of the study. Its specific method was as follows:

(1) Questionnaire Survey

We sent a questionnaire on problems in practical use of biotechnology to research managers of firms that were conducting research and development in biotechnology. (Out of 320 subject persons, 211 responded.)

(2) Hearing Survey

We interviewed firms that had already achieved a practical use of biotechnology, and asked about the background and content of the practical use and their opinion on practical use (5 subject organizations).

(3) Other Document Survey

A. Trends of Research and Development in Biotechnology

Based on existing literature and statistical data, we surveyed and analyzed overall trends of research areas, funds, and personnel.

B. Present State of Gene Resources

We surveyed preservation, utilization and problems of gene resources, which are the basis for research and development. (The person in charge: Koshio Kumaya, Visiting Researcher)

2. Study Results

As for practical use of biotechnology, various products are under development in areas such as medicine, seeds and saplings, and food. The results of our questionnaire survey show that the research managers of private enterprises, which are the main driving force toward practical use, have relatively high assessments of the present state of practical use, as is shown in Figure 1. We think these assessments include not only assessments of something that have already been materialized as products but also assessments of "creation of new knowledge (increase of understanding on living things)", which is one of characteristic features of biotechnology.

On the other hand, while the huge potential of biotechnology invites high expectations on product innovation and process innovation in various areas for further progress of practical use, the respondents to our questionnaire cited many problems, such as "research is insufficient in basic research areas", "biotechnology alone has a limitation", "research is

insufficient in application and development areas”, and “number of researchers is not enough” (see Figure 2).

In our hearing survey (private enterprises, etc.), the main opinions on what is needed toward practical use are the following:

- Promotion of basic research (to learn and understand natures and forms of living things which produce a variety of substances)
- Combination of specialized techniques (including techniques other than basic techniques such as gene recombination) in different types of industries (exchange of seeds, exchange of seeds and needs)
- Promotion of cooperation systems among industry, academia and government
- Thorough PR activities for public acceptance
- Administrative response in line with progress of technology and trends in other countries (concerning with safety, intellectual property right, etc.)
- Promotion of original research, etc.

Behind the cases of practical use by private enterprises that were the subjects of our hearing survey, we recognized self-help efforts, long-term accumulation of techniques (particularly peripheral techniques, such as separation, refining, and other process techniques), establishment of collaboration systems with universities or other enterprises, and establishment of total product development systems including creation of new markets.

3. Problems for practical use

Putting together the results above and other surveys, and considering and arranging the problems in practical use of biotechnology, we obtain the following:

(1) Understanding Living Things (Improving and Strengthening Basic Research)

Most important thing to do is to deepen understanding on living things which is the origin of biotechnology. For this end, not only constructing systematic theories on functions and structures of living things, but also “exploring new functions” has an important meaning, because biotechnology depends on (new) functions of living things. Another characteristic feature of biotechnology is that “the boundary between basic research and application is not clear; and results in basic research directly connect with application.”

Basing on these points, it will be important to promote basic research in collaboration of industry, academia and government from a long-term viewpoint. It will be also indispensable to have a databank, a gene bank, etc. to share results of basic research effectively.

In our questionnaire survey, more than half of the private enterprises answered that they were doing or preparing in-house basic research (Figure 3).

While most of the enterprises answered that they felt necessity of doing in-house basic research, many of them said it was necessary to “improve the joint research system with universities and government laboratories”, “secure good researchers”, “unify corporate policy”, and so on (Figure 4).

(2) Development of Total Production Technology Systems

Next, as “biotechnology alone has a limitation” ranked high in the results of our questionnaire survey, in order to materialize knowledge learned from living things into final forms (products), it is indispensable to develop not only basic techniques of biotechnology that directly involve living things, such as gene recombination techniques, but also peripheral techniques (particularly new process techniques, such as separation and refining) and other related (connected) production techniques simultaneously.

It is important to build up a integrated total production techniques system to the target final product in such a way, and to do research and development from such a viewpoint.

(3)Digging up and Connecting Technical Seeds and Needs

Since biotechnology has a wide variety of application areas and potential to connect with many other technologies, one of major characteristic features of practical use of biotechnology is its very wide distribution of technical seeds and needs.

Therefore one challenge will be how to dig up (exchange) these latent or distributed seeds and needs and connect them. For this reason, the role of exchange between different industries or among industry, academia and government will become more important, and support for active and smooth promotion of such exchange (establishment of places, improvement of window/mediation functions, PR of measures, establishment of accompanying system, etc.) will be required.M

(4)Coexistence with Society and Human Beings

The fourth problem sited was the one with society and human beings. In biotechnology , which deals with "living things", it is also very important to make consensus along with to develop techniques. Today, the progress of science and technology as the whole is increasingly rapid, and it is getting difficult to gain wide public acceptance slowly using a long period of time. In this sense, this problem is likely to become an important task in the future. We need honest daily efforts to build consensus, including promotion of PR activities, and we must make a basic system quickly.

(5)Other

Improvement of bases for research and development is important for the above-mentioned promotion of basic research and progress of practical use of biotechnology. According to our questionnaire survey, researchers, facilities and equipment, funds and gene resources, etc. were ranked high as necessities for the future.

Among them, fairly many research managers pointed out the insufficiency of researchers in terms of both "quantity" and "quality".

As for gene resources, numbers of preserved and distributed items at preservation (distribution) organs have been increasing in recent years, but remaining major challenges are to improve them further and to construct an information management system that contributes significantly to utilization of gene resources.

Other possible challenges toward further practical use of biotechnology are promotion of original researches, quick administrative response in terms of regulations and systems in line with progress of technology and trend in other countries, etc.