Microbiology Research Group

The Current Status of Biofuels and Research Outline of the Microbiology Research Group

1. Research into biofuels

In the year 2007, the world's attention was focused on the climate change and biofuels. Since biofuels are produced from renewable biomass and are carbon neutral, competitive R&D has been carried out around the globe to establish an efficient biofuel production technology. Although the U.S.A. has shown a negative attitude towards the global effort to cut the green house gas emission, its government is leading active involvement in the biofuel production research to ensure the country's energy security. The "Twenty in Ten" objective, aiming to cut gasoline consumption by 20% in ten years, has been proposed by President Bush and the Energy Independence and Security Act of 2007, signed into law in December 2007, sets a national Renewable Fuel Standard (RFS) requiring 36 billion gallons of renewable fuels by 2022. Twenty one billion gallons will be provided in the form of advanced biofuels produced from unconventional biomass resources including cellulosic ethanol. In Europe, biodiesel has been attracting attention as transport fuel though the bioethanol market is gradually increasing. The EU is currently debating to set an objective to increase biofuel share to 5.75% by the end of 2010 or 10% by 2020. In Asia, biofuel introduction is actively progressing in China, the 3rd largest bioethanol producer, Thailand and India.

In Japan, it is planned to "provide 0.5 million KL of biofuel by 2010" as transport fuel in order to meet the target to reduce green house gas emission set by the Kyoto Protocol. Furthermore, the government aims to provide 10% of gasoline with domestic biofuels by 2030. To achieve this, 6 million KL of biofuels, including bioethanol, is required and biofuel production with a distinctive feature of the production site has already been in progress in Hokkaido and Okinawa. In addition, the ministries of agriculture, forestry and fisheries and economy, trade and industry jointly held "innovative biofuel technology council" comprised of those from industry, academia and government in November last year. The council aims to develop an innovative cellulosic biofuel technology which does not compete with food resources and plans will be illustrated at the end of March this year.

2. Biofuels and environmental issues

Bioethanol production in the U.S.A. is on the increase and the amount produced is expected to reach 26 million KL in 2007. This led to sharp rise in corn price and the increase in production revealed various concerns associated with biofuels. The main problems are increasing competition for resources with food supply and environmental destruction (BJT/Green Innovation 2007.8.23 Vol. 1 Nikkei Business Publications, Inc). In order to solve the former problem, it is essential to achieve early bioethanol production from non-food based biomass (cellulosic biomass) and making such production process widely available. Additionally, large amount of subsidy will be provided to build a cellulosic ethanol plant. Environmental destruction resulted from biodiesel production from vegetable oils, on the other hand, requires significant technological reform, hence butanol can replace conventional biodiesel, its production is currently attracting attention. The most notable feature of butanol as alternative fuel is that it can be easily mixed with light oil. Our achievement made with biobutanol production technology from cellulosic biomass is explained in detail in Topics.

3. Research and development at RITE and the future

We are carrying out technological development on efficient biomass utilization technology with our novel technology using "Growth-arrested bioprocess" with Coryneform bacteria as the core technology (Figure 1).

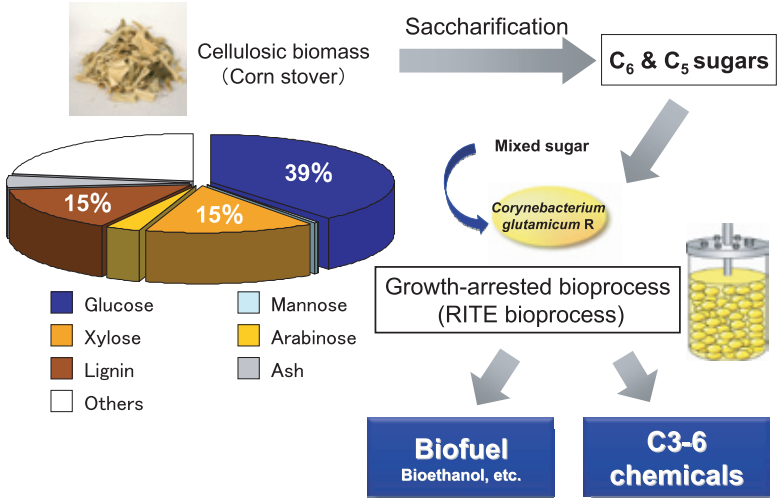

Fig. 1 Growth-arrested bioprocess

The details of the process are illustration in RITE-Today issued last year. As for biofuel production, we are currently carrying out a collaborative research with car manufacturer (Honda) on highly efficient ethanol production system from cellulosic biomass. This system is barely influenced by the fermentation inhibitors produced during the pre-treatment process and has other remarkable features. To produce chemicals of use from biomass, we are taking part in the NEDO project, "Biorefinery technology research and development". A production host used in the "Growth-arrested bioprocess" has been assigned and the biosynthesis pathway in the Coryneform bacteria has been optimized using the genome information to create strains which efficiently produce organic acids, alcohol, dioles and amino acids (Figure 2).

Furthermore, in the context of CO2 fixation technology and its effective use, fundamental research and development is conducted by focusing on individual projects including next-generation biofuel production from biomass resources (hydrogen and butanol) and technology to utilize wood-biomass (hard biomass). Among these, collaborative research is carried out with house-hold appliance manufacturer (SHARP) on hydrogen production process from biomass resources. In such process, hydrogen is continuously produced from biomass-derived sugars by genetically modified *Escherichia coli* to efficiently produce hydrogen, which is considered to be clean-energy. We endeavor to carry out collaborative research with industry to apply our "Growth-arrested bioprocess" to broader chemicals and biofuels production in the future.

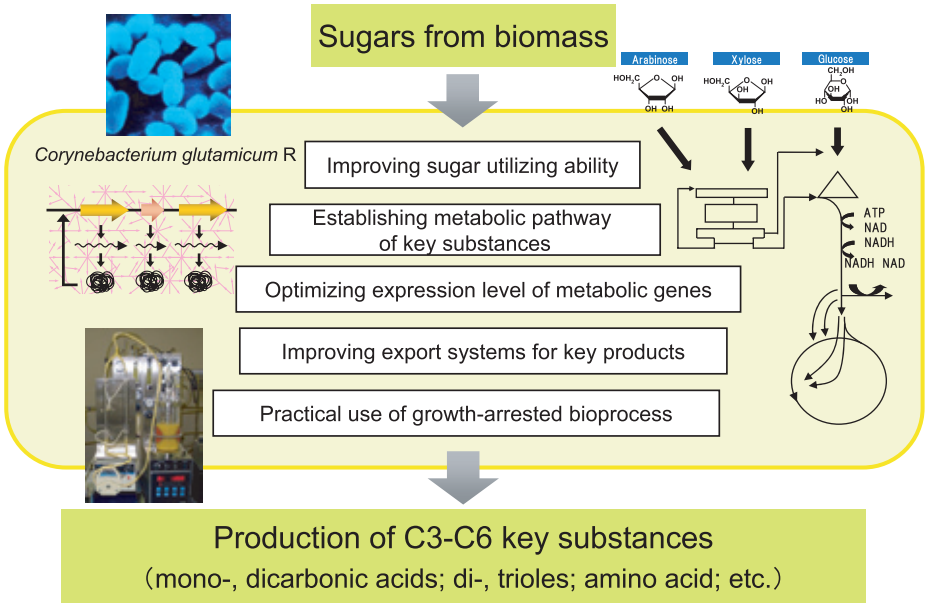

Fig. 2 Biorefinery technology research and development