



National Agriculture and Food Research Organization (NARO)



National Food Research Institute



NFRI



Roles and responsibilities

In order to promote a healthy and rich diet for consumers and to address the country's food supply issues, the National Food Research Institute (NFRI) carries out innovative research. Specifically, NFRI aims to:

1. Develop technology that maximizes the value of food and agricultural products.
2. Develop technology that provides a wide variety of safe food.
3. Offer accurate information about food products based on scientific evidence.

NFRI is the only research organization under the auspices of the Ministry of Agriculture, Forestry, and Fisheries, which conducts research specifically in the area of food related science and technology. The work of NFRI is extensive and includes the scientific analysis of food and health, the development of technology to ensure the safety of food, and the development of innovative distribution and processing technologies. While implementing the most advanced technology, NFRI makes every effort to work on the most relevant topics affecting the country and to support on-going research projects. NFRI also conducts diverse research in relation to agricultural products, ranging from the distribution and processing stages to the cooking and eating stages of the food chain.

Major research subjects

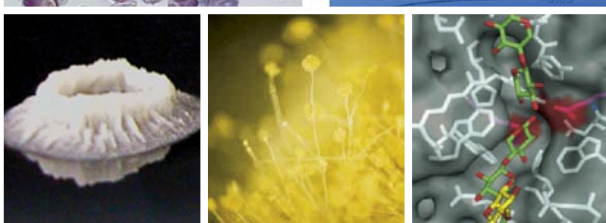
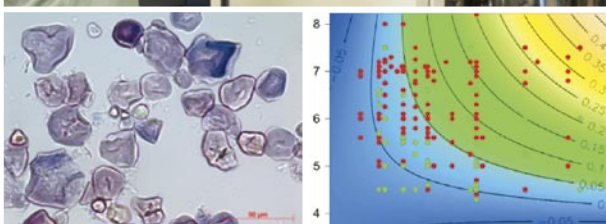
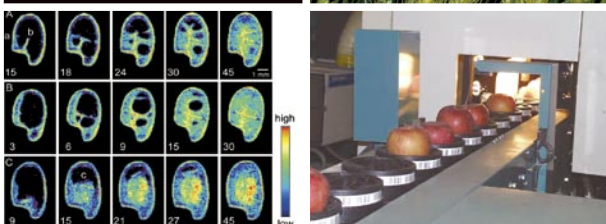
- Studying the three functions of agricultural products and foods: nutritional function, palatability and biological function, and the development of technology for their effective utilization.
- Development of technology to ensure the safety and credibility of agricultural products and foods.
- Development of distribution and processing technologies with an aim to conserve and improve the qualities and functionalities of agricultural products.

In addition to basic research and development of advanced technologies, NFRI carries out research that meets the rapidly changing needs of society.

Through the channels of the food industry as well as the agriculture, forestry, and fisheries industry, the research results obtained at NFRI have contributed to building a technical system to support a healthy and rich diet for consumers, and to secure a safe and stable food supply.

History

- 1934 : Established as the Rice Utilization Research Institute under the Agricultural Bureau of Ministry of Agriculture, Forestry and Fisheries in Tokyo.
- 1944 : Reorganized as the Office of Food Administration Research Institute.
- 1947 : Reorganized as the Food Research Institute.
- 1972 : Reorganized as the National Food Research Institute.
- 1979 : Moved to Tsukuba Science City from Tokyo.
- 2001 : Reorganized as the Independent Administrative Agency, National Food Research Institute.
- 2006 : Merged with the Independent Administrative Agency, National Agriculture and Food Research Organization (NARO) .



Organization

Director General

Department of Planning and General Administration

- General Administration Coordinator
 - Planning and Promotion Section
 - General Administration Section
 - Information and Public Relations Section
 - Cooperation and Coordination Section

Research Coordinator for Radiation Effects on Food

Food Function Division

- Research Leader
- Nutritional Function Laboratory
- Functional Food Factor Laboratory
- Functionality Evaluation Laboratory
- Physiological Evaluation Laboratory
- Sensory and Cognitive Food Science Laboratory
- Food Physics Laboratory

Food Safety Division

- Radiation and Food Science Laboratory
- Chemical Hazard Laboratory
- Food Hygiene Laboratory
- Food Entomology Laboratory

Analytical Science Division

- Food Analysis Laboratory
- Mass Analysis Laboratory
- Molecular Structure and Dynamics Laboratory
- Nondestructive Evaluation Laboratory
- Foodmetrics Laboratory
- GMO Analytical Evaluation Laboratory

Food Resource Division

- Research Leader
- Cereal Science and Utilization Laboratory
- Carbohydrate Laboratory
- Protein Laboratory
- Lipid Laboratory

Food Engineering Division

- Research Leader
- Food Processing Laboratory
- Reaction and Separation Engineering Laboratory
- Instrumentation and Information Engineering Laboratory
- Nanobiotechnology Laboratory
- Distribution Engineering Laboratory
- Food Packaging Laboratory
- Food Piezotechnology Laboratory
- Advanced Food Technology Laboratory

Applied Microbiology Division

- Research Leader
- Yeast Laboratory
- Applied Bacteriology Laboratory
- Applied Mycology Laboratory
- Microorganism Evaluation Laboratory

Food Biotechnology Division

- Enzyme Laboratory
- Biomolecular Engineering Laboratory
- Microbial Function Laboratory
- Biofunctional Regulation Laboratory
- Biofunctional Application Laboratory

Research Program 「Food Functions」

Project Manager: Director General

Assistant Project Manager: Director of Food Function Division

- Research Leader of Food Function Division
- Nutritional Function Laboratory
- Functional Food Factor Laboratory
- Functionality Evaluation Laboratory
- Physiological Evaluation Laboratory
- Sensory and Cognitive Food Science Laboratory
- Food Physics Laboratory
- Mass Analysis Laboratory
- Nondestructive Evaluation Laboratory
- Lipid Laboratory
- Food Processing Laboratory
- Distribution Engineering Laboratory
- Advanced Food Technology Laboratory
- Biomolecular Engineering Laboratory
- Head of Planning and Promotions Section
- Head of Information and Public Relations Section
- Head of Cooperation and Coordination Section

■ Food Function Research Center (virtual center), Chief: Director of Food Function Division.

Research Program 「Food Safety and Food Reliability」

Project Manager: Director General

Assistant Project Manager: Director of Analytical Science Division

- Sensory and Cognitive Food Science Laboratory
- Radiation and Food Science Laboratory
- Chemical Hazard Laboratory
- Food Hygiene Laboratory
- Food Entomology Laboratory
- Food Analysis Laboratory
- Mass Analysis Laboratory
- Molecular Structure and Dynamics Laboratory
- Nondestructive Evaluation Laboratory
- Foodmetrics Laboratory
- GMO Analytical Evaluation Laboratory
- Research Leader of Food Resources Division
- Cereal Science and Utilization Laboratory
- Research Leader of Food Engineering Division
- Food Processing Laboratory
- Reaction and Separation Engineering Laboratory
- Instrumentation and Information Engineering Laboratory
- Distribution Engineering Laboratory
- Food Piezotechnology Laboratory
- Advanced Food Technology Laboratory
- Microorganism Evaluation Laboratory
- Head of Planning and Promotions Section
- Head of Information and Public Relations Section
- Head of Cooperation and Coordination Section

■ Technology Development Center for Food Safety (virtual center), Chief: Director of Food Safety Division

■ Food Analysis and Standardization Center (virtual center), Chief: Director of Analytical Science Division

Research Program 「Value-Added Products and Processes」

Project Manager: Director General

Assistant Project Manager: Director of Food Engineering Division

- Research Leader of Food Function Division
- Sensory and Cognitive Food Science Laboratory
- Food Physics Laboratory
- Radiation and Food Science Laboratory
- Food Hygiene Laboratory
- Food Analysis Laboratory
- Mass Analysis Laboratory
- Molecular Structure and Dynamics Laboratory
- Nondestructive Evaluation Laboratory
- Research Leader of Food Resources Division
- Cereal Science and Utilization Laboratory
- Carbohydrate Laboratory
- Protein Laboratory
- Lipid Laboratory
- Research Leader of Food Engineering Division
- Food Processing Laboratory
- Reaction and Separation Engineering Laboratory
- Instrumentation and Information Engineering Laboratory
- Nanobiotechnology Laboratory
- Distribution Engineering Laboratory
- Food Packaging Laboratory
- Food Piezotechnology Laboratory
- Advanced Food Technology Laboratory
- Research Leader of Applied Microbiology Division
- Yeast Laboratory
- Applied Bacteriology Laboratory
- Applied Mycology Laboratory
- Enzyme Laboratory
- Biomolecular Engineering Laboratory
- Microbial Function Laboratory
- Biofunctional Regulation Laboratory
- Biofunctional Application Laboratory
- Head of Planning and Promotions Section
- Head of Information and Public Relations Section
- Head of Cooperation and Coordination Section

Note: the colored circles indicate the divisions and departments to which they belong.



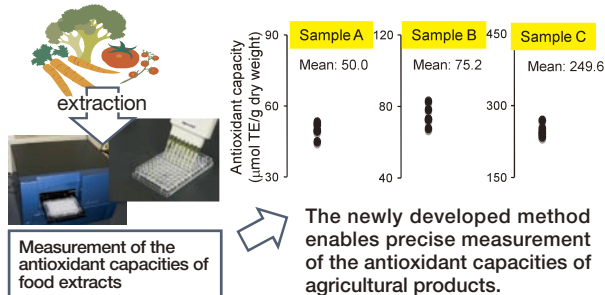
Food Function Division

To aim for the proposal that contribute to maintenance and improvement of health in super-aging society, we are working on evaluation and elucidation of three food functions including nutritional function, quality and sensory properties, and health-promoting function.

- ◆ Development and standardization of an analytical method for functional compounds in food.
- ◆ Comprehensive evaluation and analysis of food functionality using nutrigenomics.
- ◆ Elucidation of the action of nutrients, food components, combination of nutrients and food components on lipids and energy metabolism and functional expression mechanism.
- ◆ Screening and evaluation of anti-allergic or lifestyle diseases related compounds in food and analysis for their expression.
- ◆ Elucidation of the mechanisms for the taste sensation and the food preference by multiple approaches such as molecular physiological, ethological, and psychological methods.
- ◆ Texture evaluation by means of instrumental measurement, sensory evaluation and human physiological measurement and elucidation of relation between physical and functional properties of food.

Development of a validated method for measuring the antioxidant capacities of agricultural products.

- Reactive oxygen species are thought to be involved in disease development.
- The relationship between the consumption of agricultural products rich in antioxidants and disease prevention is an important research topic.
- We developed a validated H-ORAC method for measuring the antioxidant capacities of agricultural products. This method can be applied to the breeding of novel cultivars with enhanced antioxidant capacities.



Texture evaluation by mastication measurements of humans.

Food texture greatly contributes to palatability

- Sensory evaluation by trained panel
- Physiological methods such as electromyography and multiple-point sheet sensor
- Rheology and other instrumental techniques



Key technology for new food development in aging society with fewer children



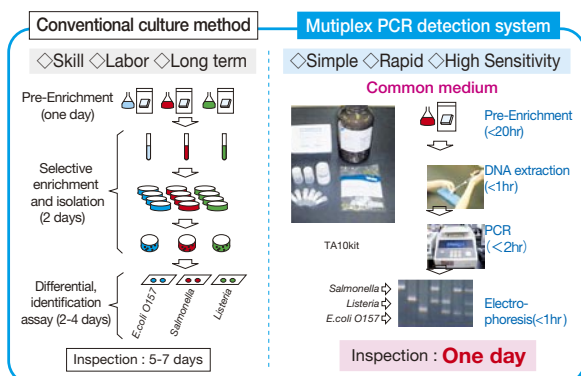
Food Safety Division

To ensure food safety, we are working on developing technologies to reduce chemical and biological hazards from farm to table.

- ◆ Development of control technology for foodborne pathogens from farm to table.
- ◆ Development of rapid detection and simple identification methods for foodborne pathogens.
- ◆ Characterization of chemical hazards such as mycotoxins and toxic elements, and development of their analytical methods.
- ◆ Development of detection and control technology for insect pests and the elucidation of their physiology and ecology.
- ◆ Development of detection technology for irradiated food.
- ◆ Elucidation of the dynamics of radioactive cesium in food processing and cooking.

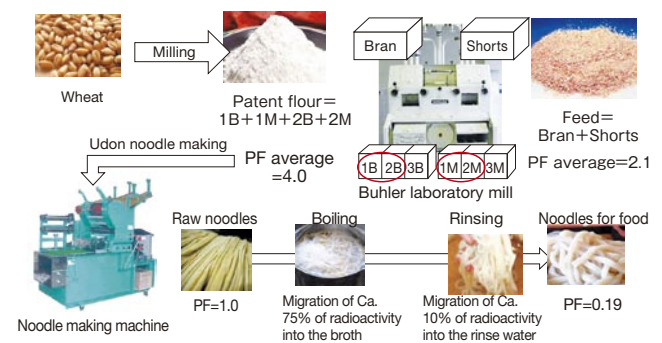
Technology for rapid simultaneous detection of multiple foodborne pathogens in food samples.

For each pathogen, this method could detect three foodborne pathogens such as O157 within one day, whereas more than five to seven days are required to detect the pathogen by conventional culture methods.



Distribution of radioactive cesium in the milling of wheat grains and the cooking of Udon noodles.

Assuming the radioactive cesium concentration of wheat grain before milling to be 100%, the concentration was found to be reduced to about 40% and 8% in the wheat flour and the boiled noodles, respectively. Therefore, when the radioactive cesium concentration of wheat grain is 50Bq/kg, the concentration of the boiled noodles becomes about 4Bq/kg.



Processing factor (PF) : Ratio of activity concentrations in the product after and before processing.



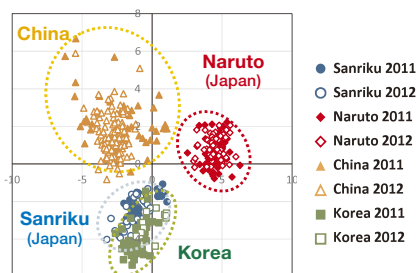
Analytical Science Division

We are developing analytical techniques for quality assurance, safety, and labeling of food. We are also performing chemical structure elucidation and state analysis of food related compounds using instrumental analyses.

- ◆ Study of sampling strategy, method validation, and statistical data analysis for improvement of reliability of analytical values and supply of reference materials and proficiency testing for quality control of analysis.
- ◆ Analyses of structure and molecular interaction of compounds related to agriculture and food by instrumental analyses such as mass spectrometry (MS) and nuclear magnetic resonance (NMR) spectroscopy.
- ◆ Development of non-destructive analytical methods for food components and chemical hazards in food.
- ◆ Development of technique for detection and quantification of chemical hazards and study of their fate during processing and cooking.
- ◆ Development of technique for detection of genetically modified (GM) agricultural products and distribution of their certified reference material.

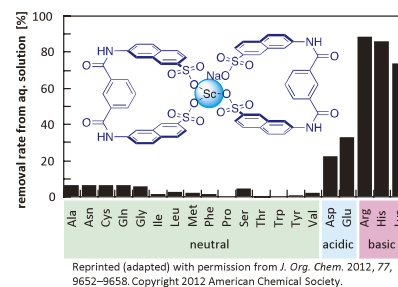
Techniques for Determining the Geographical Origins of Blanched and Salted Wakame Seaweed by Elemental and light Element Isotopic Compositions.

Analysis based on the stable isotope ratios of carbon and nitrogen and the composition of inorganic elements helps differentiate the geographical origins of agricultural products. By using this technique, the wakame grown at Naruto, Japan, was correctly predicted, even after it was blanched and salted.



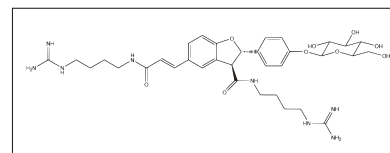
An Artificial Receptor Recognizing Amino Acids in Water.

Poorly water-soluble scandium complexes with both Lewis acidic and basic portions were synthesized as artificial receptors. One of the receptor molecules bound basic amino acids selectively in aqueous solutions of amino acids. Only a few artificial receptors are available that use electrostatic interactions as the main intermolecular binding force in water.



Chemical Structural Analysis of a Glycoside Compound in Ungerminated Barley Grain.

Hordatine A β -D-glucopyranoside localized in the aleurone layer was isolated from ungerminated barley grains for the first time and its chemical structure was determined by mass spectrometry and NMR spectroscopy.



Food Resource Division

Food Resource Division studies on clarification of quality of food materials and components, and development of their utilization methods, for increase in food value leading to demand expansion of agricultural products.

- ◆ Clarification of structure, property and functionality in carbohydrate, protein, lipid and related compounds, and development of evaluation methods.
- ◆ Development of methods for utilization of rice to rice bread and so on, and development of identification technology of rice cultivars.
- ◆ Development of conversion technologies of herbaceous biomass to bioethanol and biomaterials.
- ◆ Development of basic technologies for the production of novel food by modification of food components.

Development of bread made from wheat flour and cooked rice.



wheat flour wheat flour and rice flour wheat flour and cooked rice

The bread that contains cooked rice has high volume and sticky texture.

Development of gluten-free rice bread with glutathione.

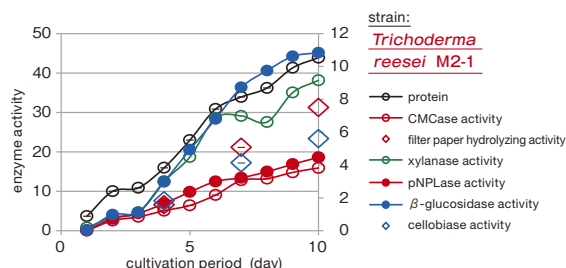
Expanded bread can be made from only rice flour with glutathione.



rice flour rice flour and glutathione Structure of rice bread with glutathione

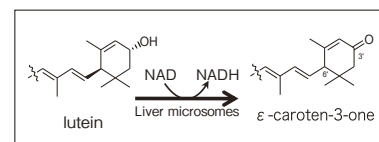
Development of methods for high production of saccharifying enzymes.

We developed methods to efficiently produce various saccharifying enzymes which are essential to convert rice straw into bioethanol.



Analysis of metabolic conversion of dietary carotenoids.

Metabolic conversion of lutein in mouse liver.





Food Engineering Division

Based on a food engineering approach, new food technologies are being studied as unit operations by analyzing the processes, improving the system, and incorporating cutting-edge technologies such as nanotechnology and IT (information technology). Some successful technologies are using our research and have already contributed to your daily life through safe and high quality foods.

Development of advance technologies for distribution and processing and its application.

- ◆ Development of a high quality and efficient distribution system by using three dimensional transport simulator (vibrator), etc., and development of packaging technologies for agriculture products and food, and quality control during distribution.
- ◆ Development of food technologies such as membrane separation, Aqua-gas® (superheated steam with hot water droplets) heating, and high hydrostatic pressure processing for high quality foods. Process analysis and optimization of food processing/cooking for improved food quality and high functionality. Development and applications of *in vitro* gastric digestion model for foods.
- ◆ Development of pasteurization by high electric field AC and radio frequency flash heating. Development of micro-channel emulsification technology for producing mono-disperse emulsions. Development of ultra-fine grinding method of food materials using a jet mill etc. and its application.
- ◆ Development of biodiesel fuel production process using Non-Catalytic Superheated Methanol Vapor Bubble Method. Development of advanced conversion processing with by-products from agro and food industry.

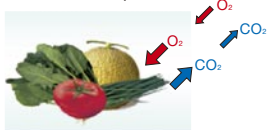
Tools for developing an advanced food distribution system



Quality evaluation of Japanese radish under simulated bulk container transport.



Evaluation test for package for cushioning of strawberries.

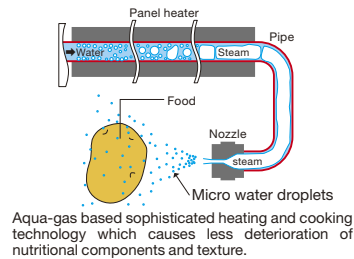


Considering the optimal packaging conditions. Adjusting oxygen and carbon dioxide is important to maintain the quality of fresh agricultural products in packages.



Transport simulation by using a three dimensional vibrator. Evaluation of physical, chemical, and physiological damage of produces.

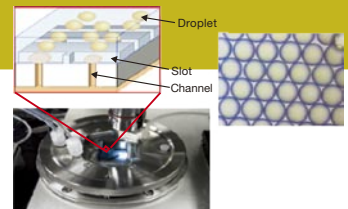
Tools for developing processing technologies



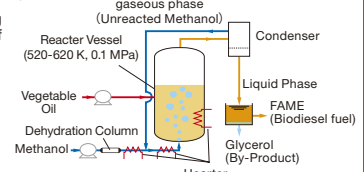
Aqua-gas based sophisticated heating and cooking technology which causes less deterioration of nutritional components and texture.



Rice flour of less than 10 um mean size can be produced using a Jet mill.



Continuous microchannel emulsification system. Uniformly sized aqueous and oil droplets can be generated.

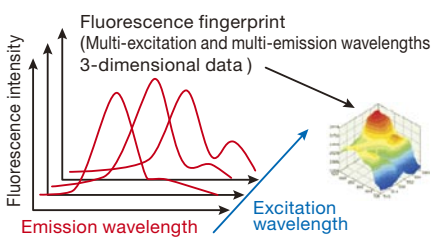


Biodiesel Fuel Production using Non-Catalytic Superheated Methanol Vapor Bubble Method.

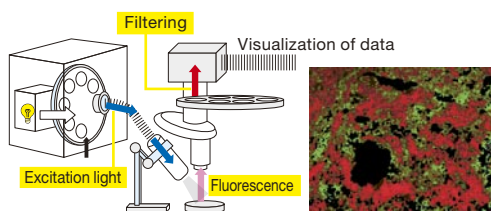
Development of advance analysis, evaluation and prediction technology for high quality and confidence and information and communication technology.

- ◆ Development of the technology of distinction and fixed quantity with fluorescence fingerprinting and imaging applications. Development of quality analysis with detection of weak intensity light signal data.
- ◆ Development of an analytical technologies to observe nano-scale structure and function using scanning probe microscope and a new bio-tool to detect targets in biological material.
- ◆ Development of a predictive model for microorganism growth and death in food and its database. Development of the evaluation tool of environmental load of food transportation by LCA and its application.
- ◆ Development of On-Line Food Traceability System for addition to useful information about agriculture products and foods and technologies to communicate research information to the public.

Developing tools for analysis and evaluation technologies

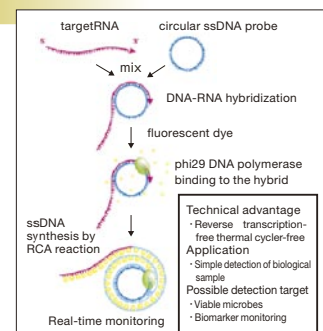


(Measuring fluorescence spectra with changing an excitation wavelength)



Fluorescence fingerprint imaging. (Visualization of constituent distribution of bread dough) Red=Protein, Green=Starch, Black=Air bubble

Technology that enables integration of a huge amount of fluorescence spectra information and performs statistical processing for target components to determine or detect components.



A new detection system using a gene tool



Applied Microbiology Division

For the improvement of the utilization technology on food-brewing microorganisms and enzymes useful in the food industries, we study elucidation of the physiology of yeasts, natto-forming bacilli, and koji mold (*Aspergillus oryzae*), search for new useful strains and enzymes, and their evaluation and utilization.

- ◆ Elucidation of an environmental stress tolerance mechanism for advanced utilization of baker's yeast, and improvement of the yeast for bioethanol production.
- ◆ Elucidation of mechanisms for material production and metabolism in *Bacillus subtilis* (natto), analysis and improvement of enzymes for the production of useful oligosaccharides, and advancement of the technology for fermentation by bacteria.
- ◆ Development of the utilization technology of food brewing koji mold (*Aspergillus oryzae*) and its enzymes using genomic information.
- ◆ Development of the technology for the evaluation and reduction of toxicity of mycotoxin using cells of microorganisms.

Post-genome analysis of koji mold (*Aspergillus oryzae*) peptidase.

The useful enzymes which were not known until now are found one after another using the koji mold genome information. The development and novel utilization of additional superior abilities of koji mold can be expected.

Fermented foods with *Aspergillus oryzae*

Soy sauce, Amazake, Sakekasu, Soy bean paste, Mirin, Rice wine

Containing many kinds of peptides

Degradation of protein by proteases from *A. oryzae*

Release of tast molecules (amino acids, peptides)

Aminopeptidase (AP) releasing amino-terminal amino acid from peptides

A. oryzae genome information
ca. 12,000 genes

NITE DOGAN

More than one hundred peptidases found!
Including novel type of aminopeptidases

Post-genome analysis

Enzymes of different substrate specificity

- Leucine AP
- Broad substrate AP
- X-Prolyl AP

Utilization of efficient production for functional peptides
Taste improvement

Public presentation of a baker's yeast gene database.

We analyzed genetic information of the baker's yeast and constructed a database to help the study on yeasts. It can be helpful for all the researchers widely from fundamental research to application or development sections such as universities or companies.

DGBY パン酵母遺伝子データベース Yeast Lab

Database for Gene Function and Expression of Baker's Yeasts

Baker's yeast is exposed to severe stresses during yeast production and bread baking

air-drying water content 4~8% (dried yeast production)	high osmolarity 30% sucrose (high-sugared dough)	freeze-thaw -20~-30°C (frozen dough)
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We have a lot of data regarding genes that may be involved in stress tolerance by using two post-genomic approaches:

- 1) genome-wide gene expression analysis using DNA microarrays (transcriptomics), and
- 2) genome-wide screening of *Saccharomyces cerevisiae* deletion mutant collection (so-called phenomics), and then uploading the data on the web-site.

<http://www.naro.affrc.go.jp/org/nfri/english/Useful/yeast/index.html>



Food Biotechnology Division

We are working on basic research to reveal, to utilize, and to improve biological functions for effective utilization of biological and food resources by employing high technologies such as biotechnology.

- ◆ Exploration for useful enzymes and substances, improvement for their functions, and development of their industrial uses.
- ◆ Unveiling molecular mechanisms that underlie unique biochemical reactions and strict ligand recognition exerted by certain receptor proteins.
- ◆ Elucidation and utilization of unknown microbial functions, and development of new microbial breeding technology.
- ◆ Development of novel methods to determine and evaluate the structure of biopolymers in solution.
- ◆ Elucidation of mechanism on differentiation and metabolic regulation for application on plant breeding.
- ◆ Characterization of enzymes useful for the utilization of agricultural waste and food processing waste.

Structure function analysis of β -L-arabinopyranosidase.

A new enzyme named β -L-arabinopyranosidase was discovered. The enzyme is involved in the degradation of exudate gums and is expected to be used for the improvement (modification) of the properties of the gum.



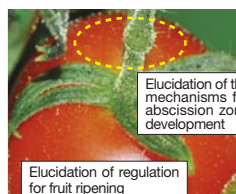
The core-structural disaccharide of human milk oligosaccharide produced in kg-scale by our novel enzymatic method.

We have revealed that bifidobacteria secrete the enzyme to liberate the particular disaccharide that acts as the bifidus factor from human milk oligosaccharides. We have also developed a practical enzymatic method to produce the disaccharide.



Elucidation of fruit-ripening mechanisms in tomatoes.

Molecular mechanisms for ripening and abscission of tomato fruits are under investigation.



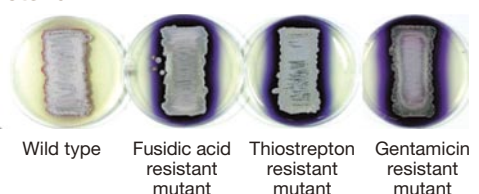
Development of a method for the automated synthesis of oligosaccharides.

We have developed a method for the automated synthesis of oligosaccharides by coupling various kinds of one monosaccharide donors after another. We have synthesized trisaccharide successfully by using this method.



Hyperproduction of a blue-pigmented antibiotic by certain drug resistant mutants of a soil bacterium.

We have demonstrated that introduction of certain drug-resistance mutations that alter ribosomal functions is effective for improvement of bacterial capabilities. Our approach opens up new avenues for efficient strain improvement.





Access



Tsukuba Center – NFRI

Tsukuba shuttle bus service, 15 min or TAXI

Tokyo – Tsukuba Center

Tokyo-Akihabara-Tsukuba

Tokyo- Akihabara , JR Line, 5 min
Akihabara-Tsukuba, Tsukuba Express Line,
45-55 min

Tokyo-Tsukuba Center

Highway bus service, 65 min

Airport – Tsukuba Center

Tokyo International Airport (Haneda) -Tsukuba Center
Highway bus service , 120 min

Narita International Airport-Tsukuba Center

Bus service, 100 min

Ibaraki Airport-Tsukuba Center

Bus service, 60 min

Tokyo-Ueno-Ushiku-NFRI

Tokyo-Ueno, JR Line, 15min
Ueno- Ushiku, JR Joban Line, 55 min

Ushiku-NFRI, Bus service, 30 min or TAXI

For more information, please see “Access to NARO” on the following website.

<http://www.naro.affrc.go.jp/english/>



Collaborators with NFRI

Overseas Organization and Universities

- University of Dhaka (the People’s Republic of Bangladesh)
- China Agricultural University (the People’s Republic of China)
- Institute of Agro-Food Science & Technology, Chinese Academy of Agricultural Sciences (the People’s Republic of China)
- Central Food Technological Research Institute (the Republic of India)
- Korea Food Research Institute (the Republic of Korea)
- Kasetsart University (the Kingdom of Thailand)
- National Food Institute (the Kingdom of Thailand)
- Rajamangala University of Technology (the Kingdom of Thailand)
- United States Department of Agriculture (United States of America)
- United Nations University

arranged in alphabetical order of the country

Domestic Organization and Universities

- National Institute of Health and Nutrition
- National Institute of Advanced Industrial Science and Technology
- Food and Agricultural Materials Inspection Center
- Japan Association for Techno-innovation in Agriculture, Forestry and Fisheries
- Ibaraki University
- Ochanomizu University
- Shizuoka University
- Seitoku University
- University of Tsukuba
- The University of Tokyo
- Tokyo University of Agriculture
- Tokyo University of Agriculture and Technology
- Tokyo University of Science
- Tohoku University
- The University of Tokushima

arranged in the order of the Japanese syllabary



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