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
- 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
    - Food Analysis Laboratory
    - Nondestructive Evaluation Laboratory
    - Lipid Laboratory
  - 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
    - 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 Processing Laboratory
    - Food Hygiene Laboratory
    - Mass Analysis Laboratory
    - Molecular Structure and Dynamics Laboratory
    - Nondestructive Evaluation Laboratory
    - Research Leader of Food Engineering Division
  - Food Processing Laboratory
  - Reaction and Separation Engineering Laboratory
  - Instrumentation and Information Engineering Laboratory
  - Research Leader of Applied Microbiology Laboratory
  - Yeast 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 superaging 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, ethnological, 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

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.
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 Elements 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 8-β-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 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.

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.

Analysis of metabolic conversion of dietary carotenoids.

Metabolic conversion of lutein in mouse liver.
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 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.
- Transport simulation by using a three dimensional vibrator. Evaluation of physical, chemical, and physiological damage of products.
- Considering the optimal packaging conditions. Adjusting oxygen and carbon dioxide is important to maintain the quality of fresh agricultural products in packages.

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

- Fluorescence fingerprint imaging. (Visualization of constituent distribution of bread dough)
  - Red=Protein, Green=Starch, Black=Air bubble
  - Fluorescence fingerprint imaging. (Measuring fluorescence spectra with changing an excitation wavelength)
  - Emission wavelength
  - Excitation wavelength
  - 3-dimensional data

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

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.
Access

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
- Seioku 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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