RESEARCH

DEVELOPMENT

INNOVATION

FIRDI

2022 Annual Report

Food Industry Research and Development Institute

Food Industry Research & Development Institute

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FIRDI Web

FIRDI Line@

FIRDI Fb

Facebook and LINE@ are important marketing tools for the Institute to communicate with the industry. We provide channels for real-time contact with the industry through digital marketing tools while enhancing real-time interaction with the industry; diversified information of global trends, regulations, seminars, technical and industrial knowledge of the food industry are irregularly delivered every month to provide industrial services in all aspects.

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Preface

In 2022, the COVID-19 pandemic, the Russian invasion of Ukraine, and climate change have greatly destabilized the global food supply chain and exacerbated inflation. As a result of the evolution of digital technology and the rapid changes in virtual and actual consumer demand, food industries have been confronted with high levels of uncertainty, risks, and difficulties, but they have also gained access to new market opportunities.

In 2022, the Taiwanese food industry overcame a series of environmental challenges with a total output of NT$758.8 billion, a 10% increase compared with the output of 2021, thus surpassing the NT$700 billion mark for the first time in its history. Therefore, to highlight the value of supply chains, the industry must now prioritize enhancing its innovation capacity and operational resilience.

In response to the trend of industrial digital transformation and net zero carbon emission, the Food Industry Research and Development Institute (FIRDI) hosted the 2022 FIRDI Foresight Camp, which built on the FIRDI 54 campaign in 2021 for planning and seeking a consensus regarding the topics of digitization and sustainability, ecofriendly ingredients, net zero carbon emission, smart manufacturing, smart food safety, power of diet, biological empowerment, and financial sophistication. This year, the FIRDI aims to continue enhancing the digitalized food defense systems for food safety in order to allow industry owners to meet international standards through food safety management. In accordance with the transformation strategies adopted by international food companies, and given the current need of domestic Taiwanese industries, the FIRDI has aided Taiwanese food companies in implementing digital transformation with customized solutions, resulting in a substantial spillover effect. In response to the net zero carbon emission policies, the FIRDI has visited factories for carbon emission diagnosis and consultation to provide industry owners with a reference for formulating carbon reduction measures and strategies. The FIRDI has also cooperated with food, packaging material, and logistics industries to manage greenhouse gas emissions.

To guide the food industry in terms of food science and technology innovation research and development, the FIRDI has utilized food texture and structure innovation, smart technology, key technological integration and application, productization, and certification service platforms. For instance, in 2022, the FIRDI established a multi-ingredient and multi-shape software and hardware technology for Chinese noodle manufacturing to overcome the raw material addition difficulties in the manufacturing process. Consequently, numerous products, including lacto-ovo vegetarian and gluten-free noodles, were developed. The FIRDI also collaborated with food machinery companies to develop multi-shape noodle machines and introduce them to the market, thereby fostering a robust multi-ingredient and multi-shape noodle industry in Taiwan. To provide manufacturers with a comprehensive tasting test service, the FIRDI developed a digital sensory evaluation system. The FIRDI also established a plant-based beverage regulation and trial production platform for use in the industry. Consequently, the first almond milk product in Taiwan was developed and exported to the Southeast Asian market.

In terms of the research, development, and application of biological resources, the FIRDI is one of the few research institutes capable of researching and developing in both food and biological resources worldwide. Similar to the American Type Culture Collection (ATCC) and the German Collection of Microorganisms and Cell Cultures GmbH(DSMZ), the FIRDI is a biological resource center with ISO certifications. In recent years, the FIRDI has been actively involved in interdisciplinary collaborations with organizations worldwide. For example, in 2022, the FIRDI collaborated with local Taiwanese hospitals to conduct in-depth research on maternal and infant probiotics. It also collaborated with American startup companies to research, develop, and apply gut microbiome food technology. To meet specific industrial requirements, the FIRDI has established an anaerobic bacteria cultivation technology platform, which can be used to produce novel alternative energy. The FIRDI has also utilized its special flavor yeasts to help Taiwanese chocolate companies manufacture dark chocolate with unique floral flavors, which received an international award.

In terms of the provision of professional inspection and analysis services, the FIRDI is an ISO-certified food inspection agency and has also entered a mutual recognition arrangement with the International Laboratory Accreditation Cooperation (ILAC-MRA) to ensure that its inspection meets international standards. In 2022, to optimize the quality of its inspection services, the FIRDI developed a digital commissioning analysis services

system to provide 24/7 online contracted services. The FIRDI also upgraded the Food Composition Database inquiry system to provide the government with an up-to-date reference for policy promotion. In addition, the Food Additives Test Methods Database has been expanded to reinforce the safe use and management of food additives, thereby enhancing food safety control and meeting industrial requirements.

The FIRDI provides food certification services that meet the ISO and Taiwan Accreditation Foundation (TAF) standards. It helps the government promote food safety management systems, such as traceability management of agricultural and aquatic products; certification of production and sales records, packaging, and circulation; and the Hazard Analysis and Critical Control Point System (HACCP) hygiene evaluation system for the catering industry. The goal of the FIRDI is to become a Safe Quality Food Institute-certified food inspection agency that can help domestic industrial quality assurance systems meet the standards of international companies. In response to the complete renovation of the Taiwan Premium Agricultural Products Certification(CAS) , the FIRDI has passed the TAF accreditation and has become a CAS certification agency.

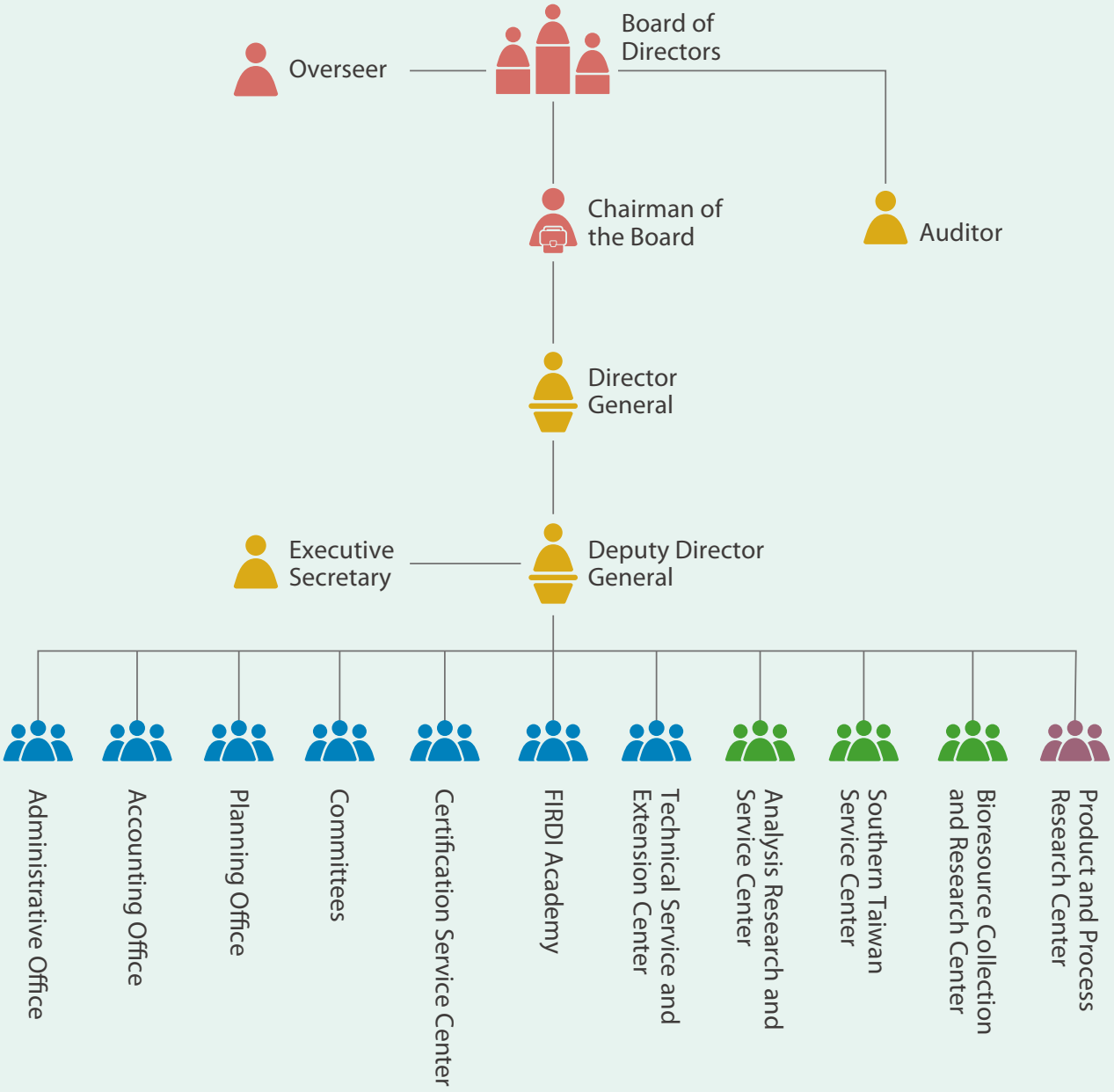
Being the largest food professional training institution in Taiwan, the FIRDI provides the Taiwanese food industry with interdisciplinary learning, multidisciplinary training, and qualification assessments of food industry talents. With Taiwan becoming an aging society, the FIRDI has launched a series of senior-friendly food training courses. Moreover, to meet the demand in the export market and the increasingly stringent international food safety management standards, the FIRDI has implemented a series of practical training programs on international food regulations. The FIRDI has also continued to improve its software and hardware facilities for talent cultivation by developing digital teaching materials, creating on-demand courses, and renovating student dormitory to provide a convenient and comfortable learning experience.

At the 2022 Taiwan Innotech Expo, thanks to the collaborative efforts of its members, the FIRDI received a numerous prestigious awards, including two gold and two silver awards, for its patented inventions. Its third-generation multidimensional fiber vegetarian meat technology won both the Science and Technology Appreciation Award and the TREE Award. Hereby, I would like to thank all members of the FIRDI for their active pursuit of various objectives. I expect all FIRDI members and personnel across all disciplines to continue improving themselves and to continue contributing to the sustainable development of Taiwan's food and biotechnology industries.

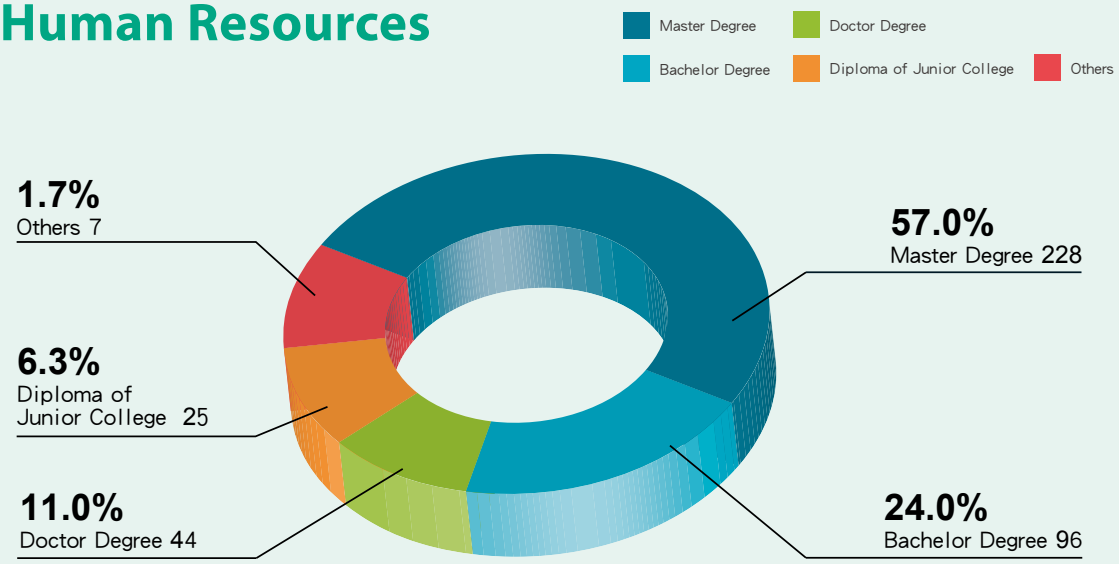
Director General
Dr. Chii-Cherng Liao

May 2023

Organization



Human Resources



Number of employees：400（2022．12）

Management team of FIRDI.

Product and Process Development

The Institute was in line with food safety and sustainable production policies, clean labeling and plant-based product trends. Researches on the food development, such as clean labeling and the concept of seniors, which related process applications e.g., extrusion, drying and application of AI has been focused recently. Through the introduction of new technologies and the refinement of traditional technologies, the group would continue to strengthen core technology area, i.e., formula, process, equipment and product research and development, and assist in industrial innovation and process optimization. In 2022, the group have been focused on multi-level flavor design of food materials, value-added agricultural and livestock raw materials, food texture adjustment, high nutrient density technology and product development, and the application of AI in the food industry.

Infrared characteristic band drying equipment.

Design, Development and Application of Multi-level Flavor Presentation of Food Materials

Manufacturing and taste design of plant-based foods : Focusing on inadequate veggie-based meat fat flavor and tastes, the group has established technology that compression molding of meat slices instead of meat, and developed plant-based frozen meat substitutes with marbling pattern and oily texture, which can be applied to the development of ready-to-cook food. Oleogel technology was developed for the production on solid fat particle by structuring the unsaturated vegetable oils which can provide the appearance and taste of animal fat when applied in plant-based meat. New sensory evaluation technology was also introduced for the establishment of information technology such as differentiation of plant-based burger meat products and identification of the outline of sensory characteristics, as the basis for taste design of plant-based meat products. In addition, in response to the problems of foaming and poor flavor of domestic plant-based milk, the group has integrated enzyme transformation and flavor control technologies for the development of oat milk for aseptic packaging latte, without adding flavors and emulsifiers, which has effectively improved the coffee blending and overall preference of the product spend.

Plant-based frozen alternative meat slices with marbling pattern and oily texture.

Plant-based burger patties with oleogel.

Development and quality analysis of oil-reduced crispy foods : Aiming at the problems that deep-fried and prepared foods not only have high fat content, but also have poor taste and texture after reheating , the formula design of oil injection device and the movable nozzle was integrated, and the superheated steam impingement flow technology was used for the development of frying process assistance. The new process has successfully integrated several systems and resulted in fulfilling product flavor maintenance and texture improvement after oil reduction. Using surface electromyography (sEMG) to evaluate changes in muscle movement during the process of food chewing, this can identify key quality indicators for foods of different textures. This approach solved the problem of only being able to measure physical properties, which cannot effectively quantify the sensory perception of differences in texture characteristics such as hardness and crispness for different crunchy foods. This is useful for developing new products with different sensory characteristics.

Value addition of the Commercialization of Agricultural and Livestock Raw Materials

In order to improve the multiple applications of agricultural and livestock products and by-products, solve the problems of time-consuming and energy-consuming productions, low drying efficiency and short storage period of products. Four subjects were emphasized : (1) Study on the development of fat substitutes in prepared food. (2) Research of infrared characteristic bands on jerky products. (3) Research on the online monitoring of the controlled atmosphere storage of cabbages. (4) Application of value-added for agricultural by-products.

Superheated steam impingement flow-assisted frying equipment.

Texture adjustment Teriyaki pork loin products.

Easy to chew meat jelly with dietary fiber.

High protein chicken spread.

Developments in Food Texture Adjustment and High Nutrient Density Technologies and Products

In 2022, the team has developed poultry meat texture adjustment technology and easy-to-chew prepared food. The techniques were transferred to Super Qin Group, who launched the first domestic fresh poultry that can be crushed with gum. Related technologies have been applied to 17 RTC/RTE derivative products. In addition, the team used Eatender's texture grading technology to assist UTC foods, HaoHan and other companies in developing business used, tongue crushable, room temperature storage, and high nutritional density products, e.g., pork chop, rice snacks and spread sauces to meet the special needs of medical and group meals. Among them, the team assisted Hao Han in building the first domestic production line of crush-with-tongue rice snack that could be sold at room temperature. The protein content of this product could be greater than 9.0 g/100g, and the calcium content is more than 100 mg/100g, of which has led the industry.

In addition, the team also used materials that are not fully utilized in the chicken processing industry, such as chicken essence, to develop "chicken oil ingredients" that have both high oxidation stability and high-calorie density. At the same time, the active oxygen method and the accelerated test mode of oil oxidation were established to assist the industry in evaluating the quality of chicken oil after extraction and the time required for process adjustment, to improve the efficiency of raw material application, and to derive applications for Eatender foods. For example, high-protein chicken spread, which will help solve the problem of insufficient caloric intake in seniors.

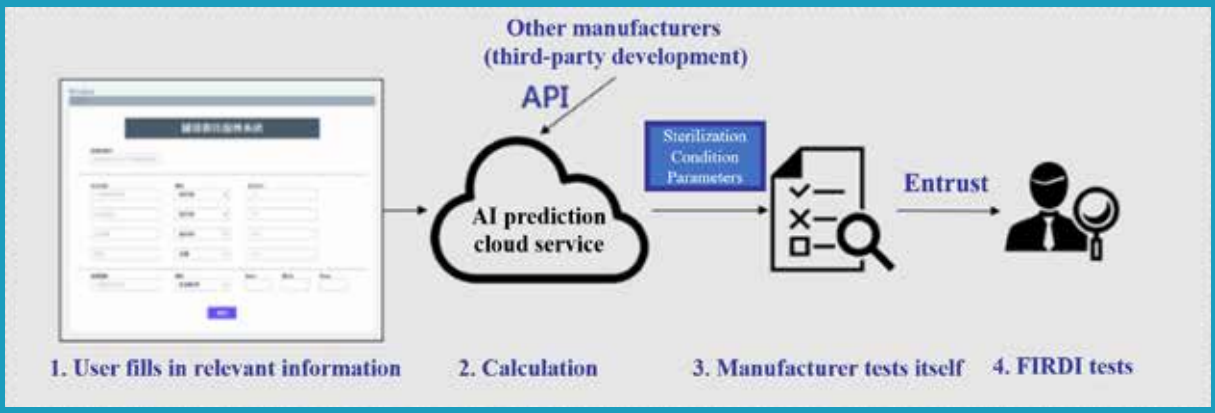
Promote the Application of AI in the Food Industry

Since 2018, the Institute has focused on connecting smart technologies with cross-field resources, evaluating and introducing the core competency of AI technology to the food industry. In 2022, the group focuses on the application and development of smart production design of alternative food materials, real-time sensing of food quality in the drying process and numerical prediction of canned food sterilizing value. Based on the correlation analysis of raw material characteristics, process modules, equipment specifications and quality indicators, and related data, an intelligent production model or expert system with predictable capabilities was established. The main achievements of year 2022 include an intelligent production model of fructooligosaccharide and microalgae protein, an intelligent design of microbial simulation oil, and an expert system of impingement powder drying process and canned food sterilization. In the future, these will lead the food industry towards the goals of quality control visualization, quality standardization, and information digitization.

The intelligent production design of alternative food materials : The Institute focuses on the process design of fermentation, transformation, extraction and purification. Through the analysis of the correlation characteristics of technical parameters, yield, and quality indicators, a smart production model of oligosaccharides and microalgal proteins with predictive capabilities was established. It can provide new product development, process optimization testing, and key module design to achieve the purpose of simplifying process control and stabilizing product quality. It serves as an important basis for promoting the innovation, upgrading and transformation of alternative ingredients for industrial technology.

Technology for real-time sensing of product quality in drying processing : Determination of product drying endpoint often relies on professional experience or random sampling analysis. As a result, under-drying or over-drying often occurs, resulting in quality deterioration and other problems. In 2022, the group has introduced near-infrared spectroscopy and water activity rapid monitoring equipment to build a real-time sensing technology for impingement powder drying process products. It can standardize, digitize, and cloudification product quality, which also conduct comprehensive, rapid product visual quality control. It can also be applied to various processes and as a key technology for digital transformation of industry.

Artificial Intelligence (AI) prediction cloud service for canned food sterilization condition : In order to assist canned food manufacturers to quickly develop new products in response to the market, in 2022, an AI prediction system for sterilization condition was developed with the existing canned food sterilization database in FIRDI. In the future, manufacturers can apply the system to predict its heat penetration temperature rise curve according to the specifications of the autoclave, the can information (size, type, and the proportion of the content), and then calculate the sterilization value (F_0) at each time point. With this service, the manufacturers can adjust the sterilization condition and quality accordingly, for reducing heat penetration test time and speeding up canned products to market.



Application scenarios of AI prediction cloud service for canned food sterilization condition.

Processes and Equipment Integrations

The professional food engineering expertise and technology integration ability of FIRDI lead the researches of food processing operations as well as developments of mechanical equipment in the field. Establishments of core technical capabilities and efficiency verification platform, and developments of equipment that are user-friendly, simple to operate, and, most importantly, with full intellectual property protections, allowed the industries to have stronger competitive strength in terms of equipment and quality products. In 2022, the Institute has involved in the research and development of equipment and process integration for freshly prepared beverages and plant-based beverages.

Innovation and Integration of the Freshly Pepared Beverage Industry Chain

FIRDI has been devoting to the development of intelligent mixing equipment for beverages that utilize pneumatic cassettes, as well as cloud monitoring dashboard services to monitor the status of the equipment remotely. This technology allows the plant-based flavored drinks production line to be customized based on aroma and taste preferences. FIRDI has also been working with domestic machinery manufacturers for development a beverage preparation system that takes into account raw material supply and application needs. Through the integration of hygienic design technology and safety management procedures, the group are aiming to drive standardization of beverage preparation procedures, reduce labor costs, and minimize flavor modulation errors.

The field test of intelligent mixing equipment for freshly prepared beverages was performed in the Southern Taiwan Innovation & Research Park.

Plant-based Beverage Equipment and Process Integration

With the growing market in plant-based beverages, food manufacturers are eager to "enlarge the production output". However, scale-up of the blending system for plant-based dairy is limited due to the complex properties of protein & oil that hinder the process from well dispersion & emulsification. In 2022, FIRDI developed the emulsification testing platform for plant-based drinks that involves the relationship among recipes (composition/source of plant materials), process parameters and qualities. This technique promotes the startup of local agricultural producers' cooperatives, including the integration of aseptic processing and packaging system.

Plant-based beverage processing test model.

Exploration, Value-additions and Service Optimization of Bioresources

Bioresource Collection and Research Center (BCRC) of FIRDI, as well as ATCC (USA) and DSMZ (Germany), are the only 3 out of 818 members of the World Federation for Culture Collections (WFCC), which obtained the triple quality management certifications including ISO 9001, ISO 17025 and ISO 17034. BCRC aims to continuously maintain a world-class bioresources banking facility under ISO standards to provide diversified bioresources and their related developments and services. BCRC preserves 34,986 microbial strains, 14,134 animal and human cell lines, over 1,200,000 DNA clones and 2,905 patent strains available for distribution in 2022. BCRC provided a total of 4,030 batches of bioresources and completed 1,632 cases of commissioned testing and microbial identification services in 2022. These activities can assist the applications of bioresources and promote bio-economics developments. BCRC also focused on the alternative toxicology testing of cosmetics and chemicals and has established the service platform for *in vitro* skin irritation and ocular corrosion, which follows the OECD (Organization for Economic Cooperation and Development) TG442E and TG460 respectively. BCRC has been accredited in respect of laboratory according to the criteria of OECD Good Laboratory Practice (GLP) compliance registration since 2021 and has also been accredited by the Ministry of Health and Welfare (MHW) as a GLP laboratory for cosmetic toxicity testing. The GLP-accredited services of BCRC will support our customers with much greater accessibility to the international market.

Working group of Taiwan native yeast bank and its application.

Development of Cultivation Techniques for Strictly Anaerobic Methanogenic Archaea

Methanogenic archaea produce methane as a metabolic byproduct under anaerobic conditions. Methanogenic archaea have shown great promise in producing methane, which can be used as a source of renewable energy. However, the cultivation and operation of these organisms can be very challenging. The technology platform established by BCRC provided a way to cultivate and apply Taiwan's native methanogenic archaea, and may allow the industry to be able to utilize this promising source more effectively. The platform has already provided 9 cases of surrogate breeding of difficult-to-cultivate strains in the industry. Additionally, strictly absolute anaerobic handling workshops have been opened.

Integrating DNA Barcoding, Protein Fingerprints, and Genomics into the Microbial Taxonomy and Systematics to Support Product Accreditation and Marketing

Methods in microbial taxonomy have undergone significant changes in recent years, leading to improvements in the accuracy and timeliness of microbial identification. BCRC has integrated several approaches, including DNA barcoding, protein fingerprints, and genomics technologies, to achieve this goal. For example, a database of protein fingerprints for baking and brewing yeasts was established, which allowed for rapid grouping and identification of yeast species. In addition, the BCRC has developed high-precision strain typing technology for a strict monophyletic taxon, *Lactobacillus acidophilus*, through a microbial pan-genome analysis platform. This technology can differentiate and identify various commercial strains of this taxon, which has strengthened the protection of specific strains and facilitated the certification and marketing of lactic acid bacteria products. The BCRC has provided services to 258 manufacturers, completed 794 special customized case services and identified more than 2,120 strains of bacteria in the past four years, highlighting the significant impact of these technological advancements on microbial taxonomy. Overall, these developed technologies have helped manufacturers meet legal requirements and solve export problems.

Levain starters which were made from liquid yeasts and lactic acid bacteria.

Yeast as a Versatile Tool in Industrial Applications

Antifreeze yeasts and levain starters for the bakery industry : To improve the quality and efficiency of bakery products, the team have collected and investigated potential baker's microbes from Taiwan through microbiota analysis, microorganism isolation, preservation, and fermentation. It developed high-density culture technology for antifreeze yeast and starters for the frozen bakery market. Additionally, the liquid yeast and levain starters specifically tailored for European style breads and steamed bread were developed, which could help bakeries establish scalable production of levain products. These liquid yeast starters were already applied in high protein and fiber products for a steam bread company. The levain starters were used to help bakeries improve their production processes and decrease the damage to the final product.

Development of flavors and functional craft beers from local indigenous yeasts : By utilizing the unique characteristics of local yeasts, a wide range of aroma compounds can be produced through different metabolic pathways, resulting in beers with flavors and aromas that reflect the region's terroir. The team has developed unique flavors or practical craft beers from local agricultural products and native microbes. To produce these specialty beers on a larger scale, a 100-L brewing system has been set up, and quality control points have been established to ensure consistent and high-quality beer production. This technique provided high-quality performance of fruity beers with lower juice or without artificial fragrance addition. A more natural and authentic beer experience can be offered to customers.

MOU on Gut-Breast Axis Research

Since 2016, the Microbiome Technology Platform for Industry was constructed. This platform has integrated the Microbiome analysis technology and culturomics technology to provide services including microorganism isolation, identification, strain typing, functional assessment, safety evaluation, fermentation process and microencapsulation process. The group has participated in many microbiome projects and was committed to the development of emerging industries related to the microbiome. On 31st August 2022, an MOU on Gut-Breast Axis Research has been signed by the Superintendent of National Taiwan University Hospital, Dr. Ming-Shiang Wu and the Director General of FIRDI, Dr. Chii-Cherng Liao, which is an important step forward in this area. The integration of different technologies and collaboration between organizations will continue to drive progress in the microbiome, probiotics research and development, leading to new applications and benefits for many different fields.

The MOU on Gut-Breast Axis research was signed at the Superintendent of National Taiwan University Hospital on 31st August, 2022. This MOU is an important step-forward in this area.

Assistance on Food Industry Upgrades

Promotion and Exemplary Guidance in Food Industry Digital Transformation

Compiling digital transformation guidelines and learning from international cases : By referencing prevalent transformation strategies found in the global market and the domestic food industry's current conditions and needs, FIRDI has compiled 8 major guidelines for manufacturers to execute digital transformation and make relevant plans to accelerate innovation and transformation. In addition, with the aim of solving problems and creating extra value for the industry, FIRDI has also compiled the latest digital transformation cases chosen from the global food market, which focus on 6 aspects—lean operations, product customization, service innovation, experiential innovation, flexible manufacturing processes, and marketing globalization––and has provided case information to 25 food associations to inform manufacturer members for reference for digital transformation.

"2022 Small and Medium-sized Food Manufacturers' Digital Transformation Promotion Programs Achievement Presentation" held in Chiayi.

Customized digital transformation assistance : FIRDI has adopted a Digital Maturity Index, which encompasses 5 dimensions-enterprise strategies management, digital technology applications, production procedures management, customer service management, and business model innovation - to evaluate 50 food manufactures' digital application degree and propose customized assistance programs. 18 manufacturers have been assisted in 2022 with completing their transformations, among which 3 companies have started sharing their achievements to expand their effects and influence. Ya Wei Co., Ltd. has introduced electronic forms, sales analysis, and business information collection modules for rapid and in-depth data analysis to strengthen food safety management and enhance operational benefits. Sheng Hui Pork Products Co., Ltd. has employed digitalized management in manufacturing order scheduling to reduce raw material loss. The company has also established a production-sales database to help enhance its decision-making abilities. Shan Feng Foods Industrial Co., Ltd. has utilized modules to analyze the correlation between raw materials, processing parameters, and the quality of finished products to gain an accurate understanding of raw materials characteristics for the development of formulas and the adjustment of manufacturing processes to aid in rapidly responding to customized production.

Net Zero Carbon Emission Promotion in the Food Industry

In response to the environmental management policies of international organizations and advanced countries on greenhouse gases, FIRDI has assisted the Bureau of Industry of the Ministry of Economic Affairs to develop 4 Net Zero Carbon Emission Strategies including education, in-situ diagnosis, technical guidance, and demo-site. Together with the food associations, FIRDI helped food manufacturers improve the GHG (Greenhouse Gas) assessment and reduction. In 2022, 3 symposiums and workshops, 20 in-situ diagnose successfully increase transparency and reveal the hot spot of their GHG emissions, which helped two food factories to optimize their equipment and process to mitigate the current GHG emissions. With the collaboration of supply chain partners such as packaging and transportation, FIRDI can together strengthen the solution sets to drive down GHG emissions.

Development and Guidance for Food Industry Value Creation Technology

Through the product quality improvement and preservation extension technology platform, the group has assisted industrial upgrading and developing high-quality products. In 2022, a total number of 9 factories were assisted, which included the development and introduction of the concept of clean labeling to assess natural products instead of artificial additives for mochi, bakery fillings and other products. The group has also used various antibacterial factors combined with preservation technology to prolong the storage life of pickled kimchi, as well as utilized germination processing and high-efficiency heat pump drying technology to develop functional rice products stored at room temperature. The group has also introduced high-efficiency thermal processing technology and barrier technology for the development of noodles special sauce packages etc.

Operation of the Chiayi Industry Innovation and Research Center (CIIC), MOEA

FIRDI has been assigned by the Ministry of Economic Affairs (MOEA) to operate the administration and research functions of CIIC since 2011. FIRDI has been continuously working on the promotion of CIIC, as the benchmark for innovation and as a health-oriented technology transformation and application center via resources integrated from industries, government, academia and research institutes in Southern Taiwan.

Integration of Institutional Resources and Promotion of Innovation in Industrial Technology

The "Demand-planning of Local Specialty Industries" program has integrated the capabilities of CIIC's 4 research legal parties, and provided technology service models regarding pilot production implementation, real-life experiences, and product commercialization to assist technology-upgrading of local industry. In 2022, 12 firms had worked as business tenants with research institutes in CIIC and 34 pilot plant services were provided correspondingly. CIIC, too, has assisted 2 cases/firms obtaining central/local government sponsorships in R&D subsidies.

Integrating Cross-domain Vital Technologies Research

The capabilities of CIIC's 4 research legal parties have been integrated to establish the essential technologies with food-processing, mechanical-design, sensor-monitoring and data-streaming for the supply chain of plant-based beverages. Meanwhile, CIIC have also developed multifunctional precise techniques for the blending process and a testing platform for the emulsified process to assist related industries in producing differentiated and qualified products.

To Assist Technology-upgrading of Food & Machinery Industries in Local Area

The 9 research communities set up by the research institutes stationed in CIIC have held 19 forums on specific topics in 2022, expecting to stimulate innovative ideas and cooperative opportunities within these knowledge-sharing platforms. Furthermore, CIICC have also provided professional techniques and services for businesses with 47 cases successfully, and attracted 0.9 billion investments and increased output value of 1.87 billion NTD. As for the training courses in the food industry, FIRDI held 37 classes with 823 attendees here in CIIC.

8th~10th of Nov., 2022, Advanced Training Courses of European Hygienic Engineering and Design Group, EHEDG.

8th of Jun., 2022, CIIC was rated the silver level of Intelligent Building Label (Continuation) authorized by The Ministry of the Interior.

Food Quality Assurance Services

Promoting a Shared Environment for Food Safety Defense and Control Through Digitalized Food Defense Systems

Food safety management digitalization has become a global trend. In 2019, the United States took the lead by initiating an AI pilot project and proposing a “Smart Food Safety” blueprint in 2022, which introduced digitalization tools based on the Food Safety Modernization Act (FSMA) to promote the transparency of food safety information. In addition, international certification programs such as the Global Food Safety Initiative (GFSI), etc., have also been revised based on regulations stipulated in the American FSMA. The Safe Quality Food Institute (SQFI) also focused on feasibility studies for preventing poor quality products from flowing into market channels and adopting remote approaches for supervising food factories’ safety compliance. In response to this trend, FIRDI has established a digitalized food defense system (https://fppb.firdi.org.tw), which mainly covers two dimensions: food defense plan formulation tools and specialized technology databases.

In terms of formulation tools, the system can assist companies in formulating food defense plans in 4 dimensions: food safety, food defense, economically motivated adulteration (EMA), and food quality. These food defense plans emphasize risk analysis and preventive control measures that monitored from different dimensions based on manufacturers’ characteristics and products in the food industry chain that help to connect them with international food safety administration systems and promote the upgrade of product safety protection.

FIRDI has established 4 specialized technical databases covering the contents of food hazardous factors, quality/safety control, quality optimization, and responses to export requirements. Explanatory meetings, practical workshops, and other activities have been held to promote the use of the databases in the hope of upgrading industrial food safety management efficiency by means of the Plan-Do-Check-Act (PDCA) cycle to create a learning environment that shares Taiwan’s food industry data and knowledge through the digitalized food defense system.

Regarding the database content, there have been more than 300 pieces of information related to food quality factors and attributes, the impact on the environment and consumer health, as well as hazard control methods, regulatory limits, etc., contained in the food hazardous factors database.

The quality/safety control database contains information related to 43 microbes’ generation growth time and thermal death parameters, upon which the effectiveness of manufacturing condition control measures can be estimated.

The quality optimization database contains information related to 80 incidents that signify quality instability, food items’ customs clearance blocking, noncompliance with target market regulations, etc., providing data for root cause analysis, preventive strategies formulation, and so forth.

As for the database of responses to export requirements, it provides explanatory examples of the US’ registration of food items imported into its territory, offshore food items inspection data, etc., allowing manufacturers to complete online registration by themselves and prepare for offshore inspections in advance.

Hygiene Management and Counseling for Canned Foods

In 2022, this project has visited 68 acidified canned food factories on-site. According to food processes such as hot-fill-hold procedures, continuous pasteurization procedures, and batch pasteurization procedures, guidance was provided to manufacturers regarding to the HACCP program. This project also assisted food manufacturers in adopting temperature measurement and least sterilization value (LSV) analysis techniques for the heat pasteurization of acidified canned foods, ensuring that the LSV of the produced acidified canned foods is at least greater than 0.2 minutes to achieve commercial sterility.

In addition, a series of 4 online seminars entitled "Advanced Sterilization Techniques for Acidified Canned Foods" were conducted on the e-learning platform of FIRDI Academy. A total of 246 individuals from 134 companies participated in the seminars. This online course has achieved excellent results, since the difference between the pre-test and post-test scores of the participants exceeded 30 points. This indicates that the participating companies in the seminar have significantly improved their process management and sterilization safety in relation to acidified canned foods. The satisfaction rate of the attendees for each session was also over 90%.

Promotion on the Food Industry Innovation

Expanding the Eatender Ecosystem and Establishing a Senior-friendly Dining Environment

Since 2016, FIRDI has organized the Eatender Awards selection, development, and promotion events for senior-friendly foods under projects of the Council of Agriculture. The Institute also established the Eatender logo for the selected products, published senior-friendly food texture classification specifications to lead the way in paying attention to the dietary needs of the elderly and continued to lay out the relevant business ecosystem. The Institute is also part of a project by the Industrial Development Bureau of the Ministry of Economic Affairs that helps companies develop senior-friendly products. In 2022, the Institute has continued to promote the above projects, establishing multiple technology and research service platforms to expand senior-friendly food product development and the development of the overall industry; moreover, the Institute also helped to establish senior-friendly dining environments as part of a project by the Health Promotion Administration of the Ministry of Health and Welfare.

Expansion of the scale of Eatender : In 2022, 166 products (from 67 companies) were selected, resulting in a total of 612 products (from 157 companies) were able to be assisted by the Institute to establish a texture grading system and texture quality control methods. For 16 products from 7 of these companies were practically performed with the assistance mentioned above. Also, 264 products (from 85 companies) have now adopted the Eatender label, of which 93 products (from 39 companies) included texture grading information on the packaging. The total output value of these products has reached NT$1.14 billion.

Expand guidance for elderly segmentation and counseling capacity : Establish 8 elderly characteristics from the research of consumer behavior for diet. In addition to the snacks and long shelf-life foods that the elderly were interested in, expanding the research on high-fiber and low-carbohydrate diets to assist with product market positioning and marketing strategies. Moreover, the Institute provided 3 types of senior-friendly meal co-creation workshops for counseling models and marketing verification. The Institute has helped 36 companies with product design and business model co-creation in 2022.

Establish operating guidelines for senior-friendly dining environments and promote catering venues : Formulate the "Senior-friendly Dining Environment - Operating Guidelines Draft" based on 6 major aspects. Linking with Taiwan's food texture grading system, establish 3 levels of senior-friendly food categories: general food, easy to chew, and gums mashable. Following up, the Institute will counsel 3 tourism hotel/star hotel restaurants, 4 chain or independent restaurants, and 3 community establishments based on 6 major aspects to establish the cornerstone of Taiwan's senior-friendly food environment.

FIRDI organized the "2022 Eatender Awards ceremony and launch the Eatender sales area" at the Food Taipei Mega Shows On the 25th of June, 2022.

The Institute collaborated with 12 retail channels in Taiwan to organize the "2022 Pork Party for the Elderly" shopping event, encouraging consumers to prioritize senior-friendly pork products.

Establishing the Eatender sales area and raising awareness : To create an ecosystem with the benefits of a business cluster, the Institute collaborated with 17 retail channel platforms to establish dedicated Eatender sales areas and organized the "Pork Party for the Elderly" shopping event and press conference. As a result, sales growth has doubled over the previous year. For sales and recognition improvements, the Institute also developed the interactive "Let's Puzzle" website to promote and help consumers mix and match Eatender products. The page hits have reached approximately 4.4 million people. The Institute also matched 15 businesses with 24 medical nursing facilities to match the supply and demand of food materials for business texture adjustments of the facilities.

Fun Food Taiwan: Selection, Consultation, and Marketing Promotion Simultaneously

FIRDI continues to assist the Industrial Development Bureau in promoting Fun Food Taiwan selection to improve the image of the Taiwanese food industry through innovation and creation centered on the 3 values of cleanliness, design experience, and convenience and sustainability. In 2022 the selection was focused on post-COVID-19 home-based food activities, such as baking and cooking that were divided into three categories: baked goods, prepared foods, and other foods. Both Taiwanese and foreign manufacturers participated in the selection process enthusiastically, and 98 products were selected for the awards. In particular, 16 products were selected by interdisciplinary, channel, and media experts to receive gold, silver, and special awards.

This year additional manufacturer consultation was performed based on the three values. Technical experts from the Institute assisted manufacturers of baked goods and prepared foods in enhancing the cleanliness, shelf life, texture, and flavor of their products. FIRDI also produced the first short film, "Fun Food Taiwan," to advertise and enhance the international reputation of the Taiwanese food industry. In June 2022, the film debuted at Food Taipei Mega Shows and was subsequently broadcasted on international event platforms, boosting the awareness and attractiveness of Taiwanese food within the international community.

Fun Food Taiwan awards ceremony and award-winning product display at Food Taipei Mega shows 2022.

The debut of the "Fun Food Taiwan" short film at Food Taipei Mega Shows 2022.

Promotion of Taiwan's Agricultural Regular-prepared Foods in Food Market

In order to provide foods that can be kept at room temperature for a long time and still have nutritional values for the prevention of epidemics, disasters or famine. FIRDI organized the "Taiwan's Agricultural Regular-prepared Foods" competition with the funds from Agriculture and Food Agency, Council of Agriculture, Executive Yuan. In this project, 19 products including staple foods, non-staple foods, soups, desserts and beverages were selected and listed for sale in chain stores. The characteristics of epidemic prevention foods were to be focused on the foods that could be stored at room temperature, i.e., easy storage, conveniences in usage, and functional ingredients, e.g., nutritional balances, etc. These foods could not only be used as home storage food, but also encourage the exploitation rate of Taiwan's agricultural materials.

Group photo of "Taiwan's Agricultural Regular-prepared Foods" Award-winners in 2022.

Food Industry Analyses and Knowledge Services

FIRDI implements government-related projects, gathering and analyzing Taiwanese and global food market trends in real-time, tracking and deciphering Taiwan's key and emerging food industry chains as well as diet and lifestyle changes. The Institute publishes food industry yearbooks and various research reports every year regularly, while promoting and exchanging information on important issues through reviews, forums, sharing sessions, symposiums, and other diverse formats, making it an important think tank when it comes to food industry development.

Analyzing Emerging Issues that Lead Industry Development

In 2022, the Institute has conducted an in-depth analysis of food development in Taiwan and abroad, as well as emerging issues like alternative food materials, supply chain carbon reduction, the metaverse, D2C, and industrial resilience, from the perspective of global society, technology, economy, and policy. Publish the Global Food Industry Trends - Food Industry Research and Development Institute ITIS Concept for the sixth year in a row, leading the way in corporate strategic layout. The Institute has analyzed countermeasures against carbon emissions in every step of the global supply chain in 2022, bringing the Alliance for Water Stewardship (AWS) and domestic and foreign food manufacturers together to host the first "New Future in Subtraction" conference in Taiwan's food industry, announcing the start of industrial carbon reduction actions. At the same time, the Institute was assisting the promotion of such programs as Eatender and Fun Food Taiwan from the perspective of industry analysis and planning, leading industrial development and magnifying values and benefits

Responding to Environmental Changes and Promoting the Agri-Food Industry

The high level of uncertainty in the global food supply has only worsened in the past year. Using the power of industry analysis and interactions with agri-food-related industrial associations, the Institute has helped the food industry respond to environmental changes brought on by factors such as the pandemic and the Russia-Ukraine war in 2022. The Institute also assisted the government and the industry in promoting digital transformation, net zero carbon emissions, as well as senior-friendly and plant-based foods. The Institute has continued to promote the optimization of the agri-food industry, including the establishment of development bases for local industries like the production of pork, fresh milk, quail eggs, and grains, with counseling services to help the industry grasp and strengthen active countermeasures that can improve food supply resilience.

Publish Monthly Industry Digests and Provide Market Trend Analysis Services

The *Food Industries* monthly digest is an important platform for the Institute to communicate with the industry. Our industrial analysis and R&D team regularly compiles trend columns and technical special collections every month. Special collections published in 2022 include: meat product development, novel food technology, cell therapy, emerging plant protein and plant meat, genetically engineered food, digital food defense systems, and microbial food. Expert forums were also published to share ideas on topics such as food innovation and design, food biotechnology and safety, net zero carbon emissions, digital transformation, and smart manufacturing. The Institute also publishes features on key industry development issues to diversify external promotion and communication. Also, through food industry knowledge bases, the Food Vision community membership system, and the ITIS Intelligent Network, the Institute helps companies grasp industry trends and expands information services and influence.

Food Inspection and Safety Evaluations

ARSC service team.

The Analysis Research and Service Center (ARSC) of FIRDI is an accredited laboratory in accordance with ISO 17025 in food testing, which also provides inspection services that comply with the requirements of international standards. ARSC has been granted 532 accredited testing items in food, 10 accredited testing items in traditional Chinese medicines and 4 accredited testing items in cosmetics from Taiwan Food and Drug Administration (TFDA) and 503 accreditations from Taiwan Accreditation Foundation (TAF).

On-hold to the Food Safety Trends & Expansion of the Service Capacities

In 2022, the test of glycidyl ester in edible oils and fats, and the test of mono-MCPD esters and glycidyl ester in infant formula were established in response to tightened governmental regulations in specification limits. In addition, considering the contamination of pesticide residues of ethylene oxide in ice cream or noodles posed a high risk to food safety, a new test for pesticide residues in foods-test of ethylene oxide, has been established. At the same time, in reaction to the contamination of the exported enoki mushrooms with *Listeria*, the team have established the test for *Listeria monocytogenes* in food. Furthermore, testing services were expanded at the request of customers, including the test for *Bifidobacterium longum*, *Lactobacillus acidophilus*, coumarin, steviol glycoside, crystal violet and their metabolites.

Improvement in Technology Research and Development

Since there is no existing method validation protocol available inland to serve microbiological analysis, validation of methods for lactic acid bacterial count was established to considering the demands for the application of the health food certificate. In addition, proficiency testing schemes in the microbiological analysis were held in accordance with domestic and international accreditation specifications to assist quality control in microbiological laboratories for food specialists and to reflect industrial needs in the improvement of technology and development.

Digitization of Commissioned Analysis System

The "Online Commissioned Inspection Application System" provides 24/7 services. The main function is to provide customers with direct online entrusted inspection applications, output analytical service orders and inspection price lists, and trace the progress and results of commissioned inspections online. This is beneficial for customers to manage their own commissioned inspection records history.

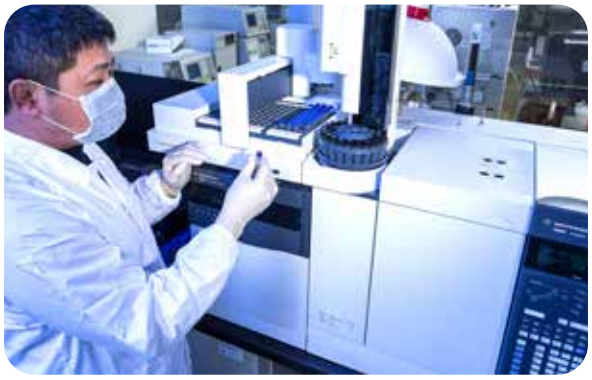
Expanding the Food Additives Test Methods Database

By carrying out the project "Evaluation for the expansion of the test methods in food additives" from the Ministry of Health and Welfare, the group have expanded and built the analysis program in 3 areas, including the development and the verification of testing methods of food additives, the compliance of food additive specifications, and the evaluation of the applicability of testing methods of food additives. Through the development of testing methods, this database fills the gap in the food additive inspection methods since the specifications and standards for food additives exist long while no corresponding testing methods were available. For example, the test method of emulsifiers and stabilizers commonly used in flavored drinks and the test method of sucrose acetate isobutyrate were developed in 2022. In addition, the group have reviewed and revised the current specification inspection methods and evaluated the suitability of the matrix to ensure that the methods were feasible. For example, the specification method of the total amount of lactic acid was also revised in 2022. Moreover, this database completes the inspection methods of food additives and improves the inspection efficiency of food additives.

Food inspection consultation and services.

Improving Taiwan Foods Composition Database

To assist the Ministry of Health and Welfare in building the "Food Nutrient Composition Database", the team have established a systematic classification for Taiwan's local ingredients, including 102 nutritional information in 18 categories, and constructed an online query system for the "Food Nutrient Composition Database". The database was revised in 2022 and introduced two elements, "precision" and "wisdom". Food ingredients and food changes over time so as the farming technology and processing in food industry. The team continue to update the database information and expand the scope of the application to improve the accuracy in regard to the eating habits of Taiwanese people today. At the same time, the team have upgraded the database network query system, and dynamically updated information and intelligence functions to provide applications from all aspects of daily life. This database can be used as an information database for policy implementation promotion, such as the "Food Nutrition Labeling System" and the "New School Lunch Innovation Promotion Plan", as well as for carrying out research, such as the Meal Nutrition Information Data System for the elderly.



The test for glycidyl ester.

The test for coumarin.

Certification Services

FIRDI has provided several types of certification services including Second-level Quality Management Certification, Good Manufacturing Practice (GMP) for Health Supplements Certification, CAS Taiwan Premium Agricultural Products Certification, Taiwan Quality Food (TQF) Certification, ISO 22000 Certification and Safe Quality Food (SQF) Certification. Numbers of food manufacturers have successfully expanded into international markets with the assistance of FIRDI. Except for secondary quality control certification and GMP for Health Supplements certification by the Ministry of Health and Welfare, the other certification services have complied with the requirements of ISO 17021, ISO 17065 and ISO 22003, and have obtained accreditation by TAF. FIRDI has continued to obtain global accreditation by JAS-ANZ for the SQF scheme, which makes FIRDI not only a domestic, but also an internationally recognized certification body.

Providing Professional Certification Services

Promote Multiple Government Certification Management Systems : There was a new conversion for CAS Taiwan Premium Agricultural Products Certification on 25th of June, 2022. FIRDI was accredited by TAF and has become a CAS certification body with 9 items including rice, brewed food, fresh cut vegetables and fruits, aquatic products, meat products, frozen food, refrigerated prepared food, ready-to-eat meal and snack food on 14th March, 2022. Achievements in 2022 include: 48 facilities have obtained CAS certification, 418 facilities have obtained the second-level quality management certification of the Food and Drug Administration, 59 production lines and 157 alcoholic beverage products have obtained the alcohol quality certification, and 273 companies counselled that complied with safety and sanitation of the factory buildings and hardware planning.

In addition, the FIRDI certification service center continues to implement Good Hygiene Practice (GHP), CAS, TQF, HACCP and ISO systems, to increase the risk monitoring of raw materials, semi-finished products and final products, which enhance the industry's knowledge of food safety-related laws and regulations and the factory's self-management capabilities.

Enhancement of Certification Services : The FIRDI has maintained its recognition by the SQFI certification body and delivered local food industries quality management to cope with international standards and integrate with the world market. The FIRDI also provided other certification services such as TQF, ISO 22000 and HACCP. During 2022, a total of 15 facilities for SQF version 9.0;114 facilities for TQF version 2.2; 27 facilities for ISO 22000:2018 and 10 of HACCP facilities were certified.

Promoting Safety Management System

Promoting the Traceability Management System for Agricultural Primary Production Farms and Primary Processing Plants for Aquatic Products : Coordinated with the Council of Agriculture, the group has published "Management method of agricultural primary production farm", the Institute continuously assisted agricultural and aquacultural industries to establish guidelines of production hygiene operations, and also assisted them to construct the primary production farms, providing safe, high quality products and stabilizing distribution in 2022. To conclude, there were a total of 42 agricultural and 5 aquacultural registrations. In addition, the FIRDI kept improve the effectiveness of traceability management system in aquatic products, by completion of 70 surveillance audits and 316 of labelled product analysis.

Agricultural primary production field survey (aquatic product) simulation training.

Promoting the Traceability and Packaging Distribution Management System Certification Program for Agricultural Products : In coordination with the Council of Agriculture, the Institute has published "Packaging and Distribution Management System for Traceable Taiwan Good Agricultural Product (TGAP) – rice, grain and special crops, vegetables, fruits" guidelines with appendix. A total of 15 publicity design and relevant expert meetings were held, with more than 702 participants. For those industries' voluntary transition and application, a total of 14 on-site visits and 3 completed transitions were conducted. Through the achievement seminar, the team has matchmade the local agricultural production processes and distribution companies for further development in multiple marketing channels.

On the 5th of December, 2022, the traceable agricultural product seminar was held at Taipei.

Promoting of HACCP Assessment in the Catering Industry : Since 2009, in order to encourage the catering industry, the government has introduced the concept of Hazard Analysis Critical Control Point (HACCP) in the cooking process, establish the Food Safety Management Systems (FSMS), of which have improved the quality of practitioners, and reduced the processing risk, to provide stringent protections for consumers' catering hygiene, safety and rights. In 2022, a total of 117 catering industries' hygiene assessments, 4 education webinars for auditors, 6 hygiene assessment webinars, and 1 award conference were implemented.

Promote and Strengthen the Traceability and Tracking Plan of Aquatic Products Exportation : Since 2017, the Institute has been coordinating the projects with the MOEA (Bureau of Standards, Metrology and Inspection) such as conducting HACCP for aquatic product industries, evaluating and investigating the management system of aquatic products exported to the EU, conducting management system surveillance witness assessments and others, to assist industries to develop and expand to international markets. Several (total number of 50) assessments, surveillance audits and relevant meetings were conducted in 2022.

Catering Industry FSMS Award conference.

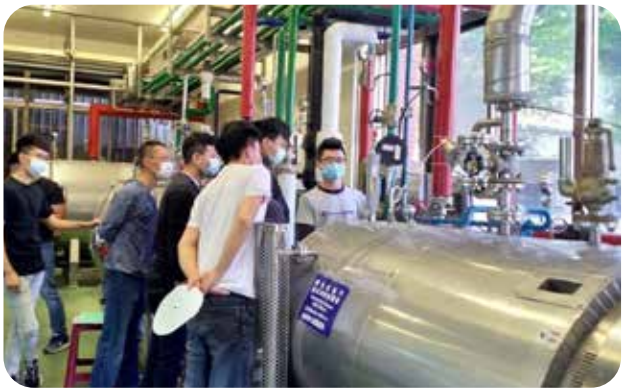
Industry Talent Training

The team of the Food Academy.

FIRDI is the largest professional training organization for the food industry in Taiwan. In 2015, FIRDI Academy was established aiming at the development of cross-disciplinary innovative courses, cultivating diverse talents. In order to enhance the quality of training services, the Academy have implemented Taiwan Talent Quality-management System (TTQS), and were awarded the Silver Medal for TTQS Training Organization Version. FIRDI Academy has also become an SQF training center and provides training courses for companies to meet international standards. Meanwhile, the Academy offer iCAP (Integrated Competency and Application) competence-oriented courses certified by the Workforce Development Agency, Ministry of Labor. FIRDI offers qualification assessments for professional food and biotechnology industry talents under the Industry Professional Assessment System (iPAS) of Ministry of Economic Affairs (MOEA). FIRDI has won the 2021 National Talent Development Awards (Non-profit Group Award) of Ministry of Labor. The Academy committed to enrich the professional talents in the food and biotech industries and providing interdisciplinary learning and diverse talent cultivation.

Professional Training

FIRDI offer professional training courses in the fields such as self-management and food defense, food safety and food quality assurance, hygiene management, food product development, food processing, canning, biotechnology, food analysis, food safety inspection, foreign market regulations, primary processing training for farmers and fishermen, food hygiene auditor training for the government health authority, and elderly food industry. In recent years, the team also offer courses in smart production, digital transformation, and net zero carbon emissions. The training was offered via various modes, including courses in person, on-demand learning, online learning, and hybrid learning. A total of 198 classes were organized and 5,618 people were trained in 2022. Training for FIRDI employees on digital transformation and net zero carbon emission was carried through 759 trainees in 14 classes.



Hands-on training courses of operating steam retort sterilizers.

Courses for Elderly Foods and Carbon Inventory : In response to Taiwan's ageing society, FIRDI has launched an Elderly Food Talent Cultivation program, which combines online learning and hands-on courses in person to train relevant personnel in the elderly food industry on food texture knowledge and skills. To meet the sustainable development needs and trends, FIRDI has formed a team consisting of main auditors with ISO 14064 and ISO14067 qualifications to hold a Food Industry Net Zero Carbon Emission Workshop. The workshop was held in the Advantech Linkou Smart Park energy management demonstration site to provide knowledge and training for food industry practitioners on organization carbon inventory and product carbon footprint analysis.

Digital Learning Materials and Services : In response to the digital learning needs, the team have developed digital learning materials in the fields such as digital transformation, smart manufacturing, elderly food, and HACCP continuous training. A digital learning service platform was established as well. In 2022, the team have trained 1,449 people via digital learning. The team have also set up a professional photography studio for high-quality audio and video training materials.

The Academy's filming studio.

Renovation of Trainee Dormitory

To create a warm, comfortable, and communicative staying environment for our trainees, the Institute have renovated the dormitory with common room areas, bright discussion areas, and balconies of greenery views. The 23 newly renovated rooms were reopened in September 2022, providing accommodation for up to 43 trainees.

Newly renovated common room and dormitory for trainee.

Professional Talent Competency Assessment

FIRDI conducts competency assessments for two types of food industry professionals, "MOEA Food Quality Assurance Engineers" and "Health Food Engineers." In 2022, 6 assessments were carried out on 43 examination sites in 78 test rooms in Taiwan and offshore islands, with a total of 5,153 applicants. Overall, 284 “MOEA Certified Food Quality Assurance Associate”, 5 “MOEA Certified Food Quality Assurance Specialist”, 367 “Professional Health Food Engineer–Entry Level”, and 11 “Professional Health Food Engineer Intermediate Level” were certified, reaching a number of 667 in total. FIRDI also promoted the recognition agreement with corporates, which gave the certified applicants priority of interview and employment. The agreements were reaching 298 in total by 2022.

The 2022 FIRDI Foresight Camp was held in Hsinchu County to discuss eight key topics with experts in the food industry.

2022 FIRDI Foresight Camp

On the 2nd and 3rd of December, 2022, the 2022 FIRDI Foresight Camp was held at Uni-Resort Mawudu, Guanxi, Hsinchu, to encourage forward thinking and reach a consensus regarding the direction of the operation, development, and promotion of relevant businesses in the FIRDI. The camp was organized on the basis of the technology and service platform promotion strategies consolidated at FIRDI's 50th anniversary in 2017, and its goal was to continue to reinforce the forward-looking plan for FIRDI's digital transformation promoted in the FIRDI 54 new campaign in 2021. Senior researchers from each center in the FIRDI participated in the camp, and experts from outside the FIRDI, such as Chairperson Pin-Tang Chang of Hey-Song, Honorary Deputy Director General Audrey Tseng of the National Biotechnology Research Park, Director General Shin-Horng Chen of the Chung-Hua Institution for Economic Research, and Chief Executive Officer Yao-Tung Hung, were also invited to provide their input during the camp. On the second day of the camp, Vice President Alex Peng of the Industrial Technology Research Institute and President Chung-Hsiun Wu of the Development Center for Biotechnology were invited to deliver keynote speeches to provide in-depth interactions on topics of net zero sustainability strategies and new business strategic thinking, which are of particular interest to legal entities.

The primary objective of this foresight camp was to establish a new generation of food products through digital transformation and sustainable development. Each FIRDI center discussed forward-thinking strategies pertaining to the 8 key topics established by the FIRDI: digitization and sustainability, ecofriendly ingredients, net zero carbon emission, smart manufacturing, smart food safety, power of diet, biological empowerment, and financial sophistication. Subsequently, the experts who participated in the camp provided suggestions and discussed the future development of the FIRDI with their peers. The chairman and director general of FIRDI were also engaged in in-depth discussions with their fellow camp participants and reached a consensus regarding the following three aspects.

1. Keep abreast of new trends and identify new niches in the food industry : Digital transformation and sustainable development are the two key trends of the food industry. Digital transformation involves smart manufacturing and smart food safety, and sustainable development requires investing in ecofriendly ingredients and net zero carbon emission. Interdisciplinary collaboration must be reinforced through talent cultivation, talent introduction, and institutional collaboration.

2. Create and guide new values of food science and technology research and development : The technological requirements of food enterprises must be identified and fulfilled using the key points of the environment, society, and governance (ESG) framework advocated by the United Nations. Resources must also be planned in accordance with relevant government policies. Technology must be used to analyze novel food-related knowledge, such as the relationship between the microbiome and human health, sensory analysis of food quality, and online detection and analysis.

3. Enhance the reputation and performance of the FIRDI in sustainable management : Food technology is the primary focus of the FIRDI. In this sense, the technological capacity of the FIRDI must be continuously improved and deepened, and its members must be continuously developed into experts, opinion leaders, and masters in professional food industry fields. The FIRDI must also rethink and strengthen the business models of its various research and development projects by transforming research and development outcomes and business opportunities into profit models, expanding the boundaries of technical services, and effectively facilitating the formation of startup companies.

Community Caring

Application of Photosynthetic Bacteria in Sustainable Crop Production : BCRC has established a culture technology for photosynthetic bacteria and working towards their applications in the agricultural and aquaculture fields. The training courses organized by BCRC guided farmers and fishermen to promote the use of eco-friendly farming practices and reduce the frequency use of pesticides. With 18 training courses and 1,100 trainees in 2022 alone, there is a growing interest in adopting these sustainable farming practices. It's also encouraging to note that over the years, a total of 68 training courses have been held and more than 3,700 trainees have been trained, including about 750 aquaculture farmers. This means that the message is reaching a wider audience, and more people are learning about the benefits of using photosynthetic bacteria in farming.

The training courses about the application of photosynthetic bacteria.

2022 Taiwan Popular Science Train- Hsinchu Station Activity : In cooperation with the National Science and Technology Council's "2022 Taiwan Popular Science Train" event, FIRDI organized a science class at the Hsinchu Train Station titled "Cans for Your Brain", which was based on canned foods from around the world, and extended to experiments on the sugar content of handmade drinks and commercial beverages. The event attracted more than 600 elementary school students from Taoyuan and Hsinchu areas, helping them to learn about canning technology and the sugar content of various beverages through practical and quiz games, allowing the seeds of science to take root in the students from a young age.


At the booth of "Taiwan Science Festival 2022", the Institute held the "Translation of Food Emerging Technology Knowledge" activity.

Taiwan Science Festival Activities, Dispelling Knowledge of Food Emerging Technology : The Institute implements the "Research, Analysis and Translation of Food Emerging Technology Knowledge" project of the Food and Drug Administration of the Ministry of Health and Welfare. On the 5th and 6th of November the "2022 Taiwan Science Festival" used "Deciphering the Future Dining Table! Food Science and Technology Knowledge You Don't Know" as the theme for large-scale public field activities. More than 700 parents and children were attracted to participate through poster explanations and game breakouts. From the event, they learned about the plant-based egg and meat products currently available in the market, as well as the concept of the food clean label that reduces food additives, together with relevant domestic certification agencies and labels.


FIRDI participated in " Active and Energetic Competition Activity for the Elderly " organized by the Chiayi city government.

Active and Energetic Competition Activity for the Elderly, Disseminate Health Care : In response to the coming of an aging society, the atmosphere of the society encourages elderly populations going out to participate in community activities to keep them healthy. FIRDI participated in the "Active and Energetic Competition Activity for the Elderly" organized by the Chiayi city government. The concept and objectives of this activity was transferred by sharing the concepts of food safety and nutrition supplements by poster presentations, Q&A activities and sending sesame soymilk products.

Social Services for Farmers and Young Entrepreneurs in Remote Areas and Outlying Islands : Using research and development technology, the FIRDI helped numbers of business owners in remote areas and outlying islands innovate and expand their market by relying on local food ingredients. For instance, the Sanwan Township business owners promoted their sterilized tapioca pearls in the US market successfully. The Shihtan Township business owners developed a wide range of products using grass jelly. The Dongshi Township business owners developed a SOD (Superoxide Dismutase) -like active fermented functional beverage based on black beans and brown rice. The Kinmen County business owners developed low-sugar, high-dietary-fiber beef jerky and black onion products rich in the antioxidant quercetin.

Online 2022 Taiwan-Indonesia Industrial Collaboration Forum.

Microbiome Applications to Develop Food System

BCRC has cooperated with a microbiome company, Notitia Biotechnology, which is a start-up company from Rutgers University, USA. The aim of this project was to develop a platform that combined guild analysis and machine learning techniques to find key features in a microbial ecosystem, as well as, extending and deepening the techniques in food ingredients studies in the new future. The group has set up a machine learning development and testing environment, designed the data analysis process, and completed the screening process. The methods combined statistics, machine learning, and genetic algorithm optimization. At this stage, there were 17 key strains selected. Based on the agreement between FIRDI, Notitia Biotechnologies and Toong Yeuan Enterprise Co., the group have proposed a test-run to evaluate the microbiome-based formulation and to assist further cooperation of three parties in the precision healthy marketing.

Workshop on Hygienic Engineering of Food Machinery for Plant-based Beverage Production

FIRDI has been authorized as the first European Hygienic Engineering & Design Group (EHEDG) testing laboratory in Asia, which provide certification and consulting service for many food equipment suppliers from Japan, Korea, Malaysia and etc. FIRDI initiated a workshop on hygienic engineering of food machinery with Danone which is the most famous food & beverage company in Indonesia, especially providing kinds of plant-based drinks in 2022. Not only do FIRDI exchange the hygiene design criteria on food equipment concerning plant-based drinks production, but also the aseptic integration & CIP (cleaning in place) techniques that increase the cleanability & quality. Furthermore, it provides the opportunity for local food equipment manufacturers to provide the total solution and increases their output value.

Online meeting with Danone Indonesia.

Taiwan-Thailand, Taiwan-Malaysia, and Taiwan-Indonesia Industrial Collaboration Summits

Taiwan-Thailand Industrial Collaboration Summit with Live Video Conference : Under the guidance of the Chinese National Federation of Industries and the Federation of Thai Industries, the 2022 Taiwan - Thailand Industrial Collaboration Summit, cohosted by the FIRDI and the National Food Institute of Thailand, was inaugurated as a dual live event in Taipei and Bangkok on 21st and 22nd of September, 2022. The summit focused on 4 fields, namely global environmental change and food biotechnology, textiles, smart cities, and automation, with both institutes aiming to identify new areas of collaboration and strengthen their partnership. During the summit, 4 letters of intent for collaboration were signed, and a new partnership was formed, thereby establishing and expanding the substantive collaboration between Taiwan and Thailand. The Food & Biotechnology Industry Subforum hosted by FIRDI extended the hot discussion of intestinal health from 2021 and focused on the potential and models of industrial collaboration between Taiwan and Thailand on probiotics.

Taiwan-Indonesia and Taiwan-Malaysia Industrial Collaboration Summits : On the 19th of August 2022, Taiwan-Indonesia Industrial Collaboration Summit was held as a dual live event. The Subforum on Food & Biotechnology Industry hosted by the FIRDI, which was well received by the summit participants, focused on trending health plants with promising potential ingredients. Future collaboration opportunities with complementary advantages were also negotiated and discussed. Starting on the 6th of September, 2022, Taiwan - Malaysia Industrial Collaboration Summit was held as a fully online event for three days, with the Subforum on Biotechnology for Food, Medicine, and Cosmetics, also hosted by the FIRDI, focusing on future smart medical industry collaboration and market-driven business opportunities.

Online 2022 Taiwan-Thailand Industrial Collaboration Summit.

Memorandum of Understanding with a Brazilian Research Institution

On 11th of August, 2022, the FIRDI signed a memorandum of understanding with the Brazilian Institute of Food Technology (ITAL). Both institutes agreed to share research knowledge and collaborate on food technology innovation, food safety, and food policies.

Signing the memorandum of understanding online with the Brazilian Institute of Food Technology.

Awards and Acknowledgements in 2022

The FIRDI developed the third-generation multidimensional fiber vegetarian meat technology to manufacture high-fidelity whole-cut meat products, thereby resolving the difficulties faced by business owners in meeting both flavor and health requirements. This innovation received the Science and Technology Appreciation Award of the Department of Industrial Technology, Ministry of Economic Affairs. During the award presentation at the Strategic Meeting of the Heads from Science and Technology, Director General Chyou-Huey Chiou of the Department of Industrial Technology presented the award to Director General, Dr. Chii-Cherng Liao, of the FIRDI.

The Ministry of Economic Affairs granted the TREE Award to the innovative texturized vegetarian meat technology developed by the FIRDI. During the TREE Award Ceremony in Taipei on the 14th of October, the award was presented by Deputy Director General Der-Sheng Lin of the Department of Industrial Technology and received by Special Assistant of Director General Yu-Sheng Chang on behalf of the FIRDI.

The patent inventions of the "Puffed Dried Rice as an Instant Food"(1) and the "Smart Multifunctional Cooking Apparatus"(2), invented and owned by the FIRDI have won the gold awards in the patented invention category of the 2022 Taiwan Innotech Expo. The "Measurement Apparatus for Dough and Method Using the Same" and the "Mold for Forming Special Shape Noodle" (3)won silver awards in the same category.


(2)


(1)

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From the 13th to 15th of October, the FIRDI's technology of Taiwan native yeast bank and its application participated in the "2022 Taiwan Innotech Expo" in Taipei and won the deciphering technology category "Best Display and Show Award" from the Department of Industrial Technology, Ministry of Economic Affairs.

The FIRDI Certification Service Center won the "Mr. Hsieh Cheng-Yuan Special Contribution Award" from the "Mr. Hsieh Cheng-Yuan Food Technology Development Foundation", and the GTP Cell Processing team from BCRC won the "Mr. Hsieh Chung-Pi Innovation Award".

FIRDI trainees participated in the "End Semester Results Exhibition of the 2022 *DIGI* + XTCA Global Digital Rising Star Awards", organized by the Administration for Digital Industries, Ministry of Digital Affairs. With "Smart Food on the Go: Cloud Gourmet," a collaborative project with the Institute and Undergraduate Program of Electro-Optical Engineering at National Taiwan Normal University, and proudly they won the third place and FIRDI was selected as the Outstanding Study Unit of the Talent Circulation Alliance.

Major Events in 2022

January

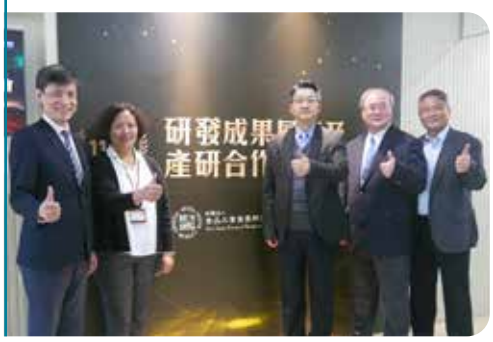
1/01 The deputy directors were appointed. All the aforementioned deputy directors shall serve from the 1st of January to the 31st of December2022.

1/28 A retirement tea party for Deputy Director Dr. Jinn-Tsyy Lai of the Bioresource Collection and Research Center, FIRDI was held.

March

3/16 3 delegates from the Digital Transformation Association (DTA) led by Vice President Ting-Yi Chan visited FIRDI.

3/29 The conference to announce "FIRDI's research achievements of 2022 and initiation of cooperation projects between industries and FIRDI" was held in Hsinchu and Chiayi on the 29th and 30th of March, respectively.



April

4/07 4 delegates from the Office of Continuing and Extension Education, Taipei Medical University led by Dean Jane Chen-Jui Chao visited FIRDI.

4/20 3 delegated from the Section of Organic Agriculture, Division of Farm Chemicals and Machinery, Agriculture and Food Agency, Council of Agriculture, Executive Yuan, led by Chief Ming-Yang Lai visited FIRDI.

4/26 2 delegates from Nestle Taiwan led by Chairperson Josephine Lo visited FIRDI.

June

6/22 The FIRDI participated in Food Taipei Maga Shows 2022 and has promoted "Fun Food Taiwan" and the "senior-friendly food products" . The award-winning products in these two categories were displayed.

July

7/18 The FIRDI established the "Office of Food Industry Smart Manufacturing and Green Production Promotion Project" which was assigned from interdepartmental teams. Deputy Director Yu-Ming Chen of the Southern Taiwan Service Center served as the office director.

7/28 The FIRDI participated in Bio Asia–Taiwan 2022 in Taipei.

August

8/11 Memorandum of Understanding Signature ceremony between the Brazilian Institute of Food Technology and FIRDI was held online.

8/15 8 delegates from Kinmen Kaoliang Liquor Inc. led by Administrative Vice Director Chi-Chan Chen visited FIRDI.

8/19 2022 Taiwan-Indonesia Industrial Collaboration Summit and Subforum on Food & Biotechnology Industry were held simultaneously in Taipei and online.

8/31 Memorandum of Understanding Signature ceremony with the National Taiwan University Hospital and FIRDI was held in Taipei.

September

9/07 2022 Taiwan-Thailand Industrial Collaboration Summit and Subforum on Biotechnology for Food, Medicine, and Cosmetics were held online.

9/16 7 delegates from the Agriculture and Food Agency, Council of Agriculture, Executive Yuan, led by Deputy Director General Chih-Wang Yao visited FIRDI.

9/21 2022 Taiwan - Thailand Industrial Collaboration Summit cohosted by the FIRDI and the National Food Institute of Thailand was held in Taipei and online.

9/23 Director General Chia-Chi Hsiao of the National Treasury Administration, Ministry of Finance visited FIRDI.

9/23 FIRDI held the "2022 Taiwan's Agricultural Regular-prepared Epidemic Prevention Food Award Ceremony and Achievement Presentation" in Taichung.

9/29 4 delegates from the Consumer Goods and Chemical Industries Division, Industrial Development Bureau, Ministry of Economic Affairs led by Deputy Director Li-Chu Wang visited FIRDI.

Major Events in 2022

October

10/04 4 delegates led by Director Yueh-Ping Liu of the Department of Medical Affairs, Ministry of Health and Welfare visited FIRDI.

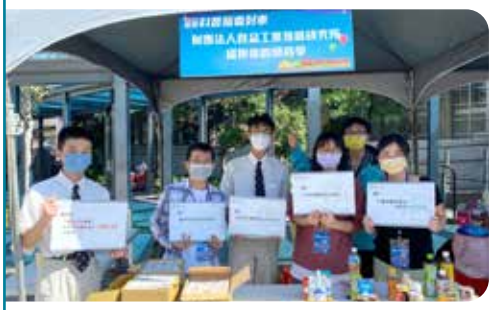
10/07 2 delegates led by Chairperson Tsih-Fei Hsiao of TEC BioWorks Co., Ltd. visited FIRDI.

10/13 The FIRDI participated in the "2022 Taiwan Innotech Expo" in Taipei.

10/21 7 delegates from the Department for Promotion of Industry and Internal Trade, Ministry of Commerce and Industry, India led by Additional Secretary Ms. Sumita Dawra visited FIRDI.

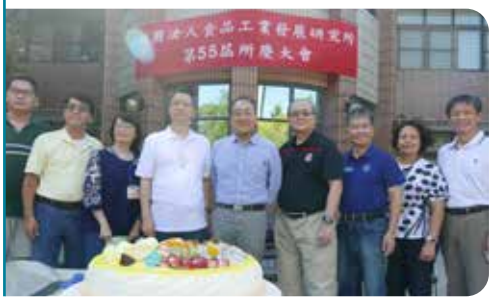
October

10/24 The FIRDI participated in the 2022 Taiwan Popular Science Train event and set up a booth at the Hsinchu Railway Station for fun experiments involving canned foods.



10/28 The FIRDI participated in the "2022 Southern Taiwan Biotechnology Exhibition" in Kaohsiung.

10/29 Events were held for celebrating the 55th anniversary of FIRDI.



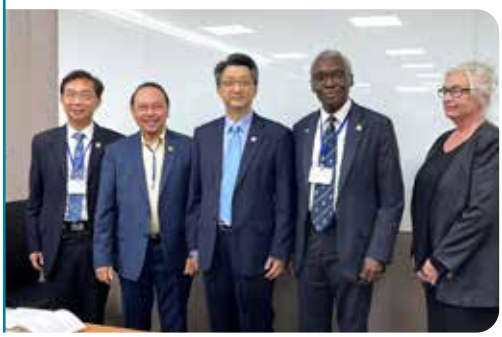
November

11/03 2 delegates from the Taipei Branch of the Soil and Water Conservation Bureau, Council of Agriculture, Executive Yuan led by Section Chief Jia-Ling Shieh visited FIRDI.

November

11/04 38 Overseas Chinese Affairs Committee members from the Overseas Chinese Affairs Committee Taiwan R&D Institutions and Industry Visiting Delegation visited FIRDI.

11/05 27 academic representatives from various countries, including Chairperson Dr. Judith Meech of the International Union of Food Science and Technology (IUFoST) and Chairperson Dr. Aman Wirakartakusumah of the International Academy of Food Science and Technology (IAFoST) visited FIRDI.



December

12/01 3 delegates led by President Tetsuro Ohba of the Japan Food Safety Management Association (JFSM) visited FIRDI.

December

12/02 The 2022 FIRDI Foresight Camp was held in Hsinchu on the 2nd and 3rd of December.

12/12 24 guests, led by Vice Principal Chu Duc Thanh of the Hanoi National University of Science and Technology from Vietnam visited FIRDI.

12/28 The Retirement tea party was held for Senior Research Scientist Chung-Liang Chu of the Product and Process Research Center, FIRDI.

12/30 8 guests, led by Consultant Po-Yen Lu of the Center for Advanced Biomaterials, Research and Development Division of Circular Technology and Material Innovation Research Park, Circular Economy Promotion Office visited FIRDI .

FIRDI 2022

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