

## ***FIRDI 2014 ANNUAL REPORT***



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## ***ANNUAL REPORT***

RESEARCH

DEVELOPMENT

INNOVATION

# FIRDI







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# Preface

Taiwan has about 6,000 food factories, most being small and medium enterprises. They employ around 120,000 people and supply about 90% of the domestic market demands, which is important for stabilizing the employment situation in Taiwan. In 2014, the food industry output (not including the tobacco manufacturing industry) reached 609.1 billion NT, an increase of 2.61% compared with the output of the previous year, and accounted for approximately 4.22% of Taiwan's total manufacturing industry output (ranking No. 8).

Although several safety and food labeling incidents occurred in 2014, the food industry output in the domestic market was not significantly impacted due to product substitution effects. On the contrary, the incidents had greater impact on export of the food industry. Faced with competition of imported products from developed countries and emerging markets in the era of globalization, FIRDI not only assists the government and food manufacturers in stabilizing and advancing the construction of the foundation for food safety, but also will continue to strengthen the innovation of products and processing to improve Taiwan's competitiveness. Especially when faced with the changes of consumption demands and life model brought by the smart-living environment, FIRDI needs to pay special attention to creating business opportunities in the food industry chain.

In 2014, poor quality edible oil adulteration incidents occurred. FIRDI actively assisted the government in carrying out the retroactivity inspection of the edible oil factories and provided professional technical commentary on oil manufacture as well as policy recommendations. Furthermore, FIRDI helped the oil industries strengthen self-management monitoring capabilities for raw materials and product quality.

In addition, FIRDI also actively assists the edible oil industry, processed meat industry, dairy product processing industry, and aquatic product industry to properly handle the incidents to coordinates with the government in promoting traceability management policies. In recent years, the repeated occurrence of food safety incidents has highlighted the lack of inspection for non-specific targets. In 2014, FIRDI was issued the Science and Technology Development Fund by the Ministry of Economic Affairs to carry out "The Preliminary Research Project on Process Optimization for Food Safety Improvement" to establish the analysis and pre-warning platform for non-specific targets, which provides a pre-warning guarding measure for the food industry safety. This will be helpful for reducing the incidence rate of similar food safety events.

Food safety should be supervised through design, manufacturing and management and cannot only depend on the detection of final products. Throughout the years, FIRDI has established a number of products and processing development technologies as well as a service platform. Under the rationale of food safety and innovation, FIRDI will assist food manufacturers in Taiwan to develop new equipments, new processes and new products. In the meanwhile, the Institute will also coordinate with the relevant departments of the government to promote the verification system for excellent foods and assist food manufacturers to establish self-management capabilities, making FIRDI an important support to the competitiveness of Taiwan's food industry. Furthermore, in the future, FIRDI will revitalize a new image of Taiwan's food industry through joint efforts from all walks of life with regards to source management, process optimization, accurate detection, and so on.

In order to meet the needs of industrial development, FIRDI integrated the original canning group with the aseptic processing and packaging group in 2014 to establish the canning business development group at the Southern Taiwan Service Center of FIRDI, and expected that the aseptic processing capacities can bring new momentum for the transformation and upgrading of the food canning industry. In addition, FIRDI continues to introduce novel non-thermal processing and newly-developed sterilization processing technology, as well as to assist the food industry in developing high-pressure processing products and commercialization processing technology to provide safe, healthy and novel processing products that will meet the new consumption patterns of the future.

In addition, the Bioresource Collection and Research Center (BCRC) of FIRDI, under the support of relevant departments of the Ministry of Economic Affairs and the efforts of this institute's colleagues, has not only been the first to introduce the ISO certification system into the field, but has also become the most comprehensive and most industrial application-oriented model of bioresources centers. The center collects a large number of local bioresources. In recent years, BCRC has also expanded its collection to microalgae and oil-producing fungi. At the same time, BCRC provides hundreds of high-quality professional services regarding bioresources and becomes an important cornerstone for the development of Taiwan's



bioindustry. In the past few years, BCRC has helped more than 10 local innovative biotechnology companies enter the market. BCRC is expected to be more active in playing an industrial cornerstone function and promoting the industrial application value of bioresources.

It is worth mentioning that the household multipurpose ohmic heating steamer and cooker developed by FIRDI under the MOEA's Project of Using Technology to Add Value won the 2014 iF and IDEA Design Award. Furthermore, the compact oil bottle stopper, another novel design product, also won the Red Dot Product Design Award in 2014. It is expected that many innovative technology research and development achievements of FIRDI can attain additional value through aesthetics and design to assist the food manufacturers in Taiwan to be more competitive.

FIRDI has established a good foundation and brand credibility under the attentive management of the director general of this institute. I have served as the director general of FIRDI since the end of August 2014 and inherited the predecessor's disinterestedly dedicatory achievements. In addition to continuously improving the core technology, FIRDI is integrating four key fields of research and development, counselling, testing, and training to provide a total solution for the food industry with a new service model. In the meantime, FIRDI will also continue to establish the service platforms of industrial economic analysis, regulatory science, and computer information to strengthen the cooperation with international organizations and domestic universities and various service capacities in order to connect with the international community.

As it faces the various issues and challenges of industrial development, FIRDI will be more active to meet the demands of the government, the food industry and the common people. FIRDI would like to have continuous encouragement and support from the advanced managers of the industry in order to make the Institute a navigator and a backup force for the active development of Taiwan's food industry.

Director General



April 2015

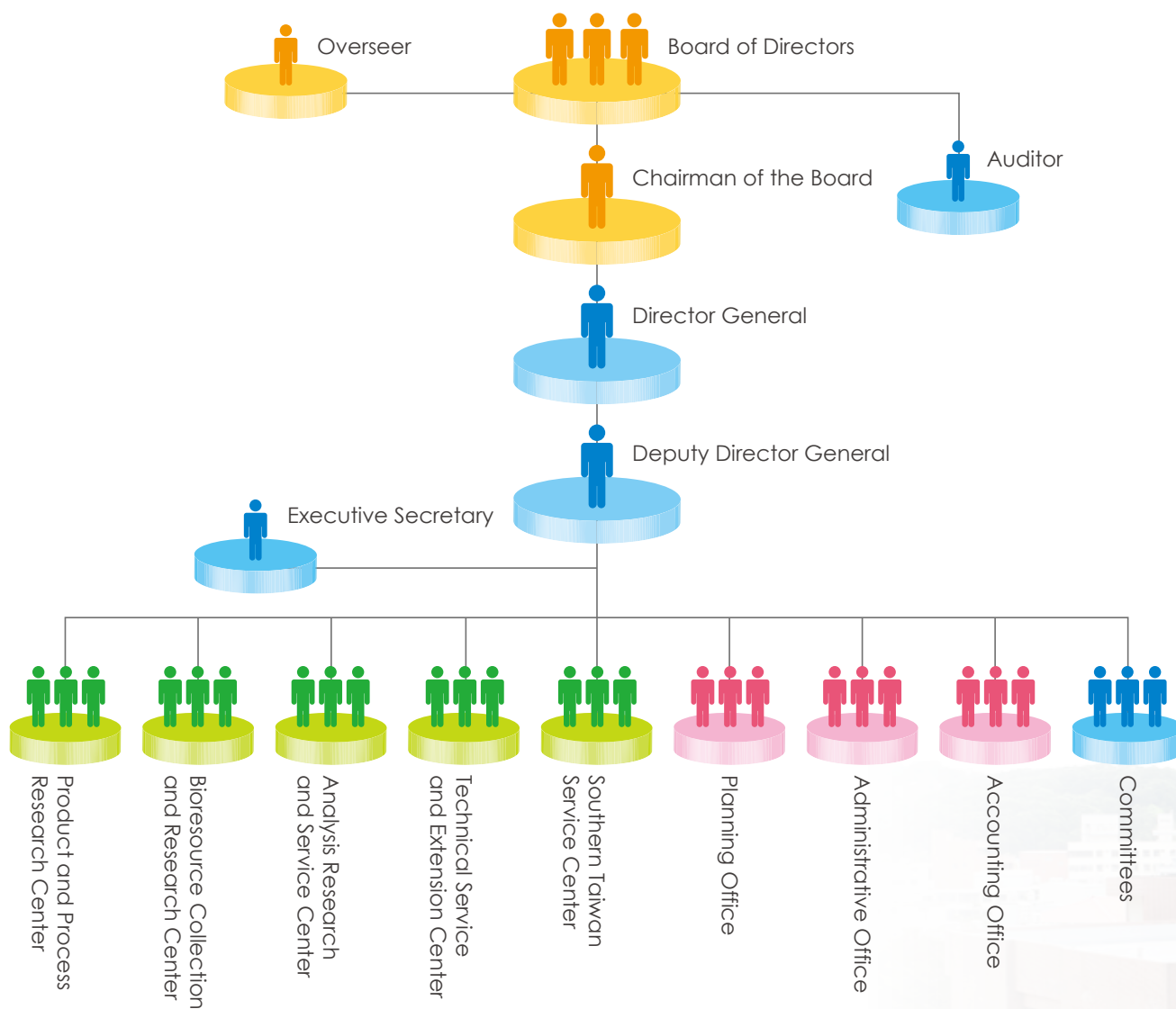






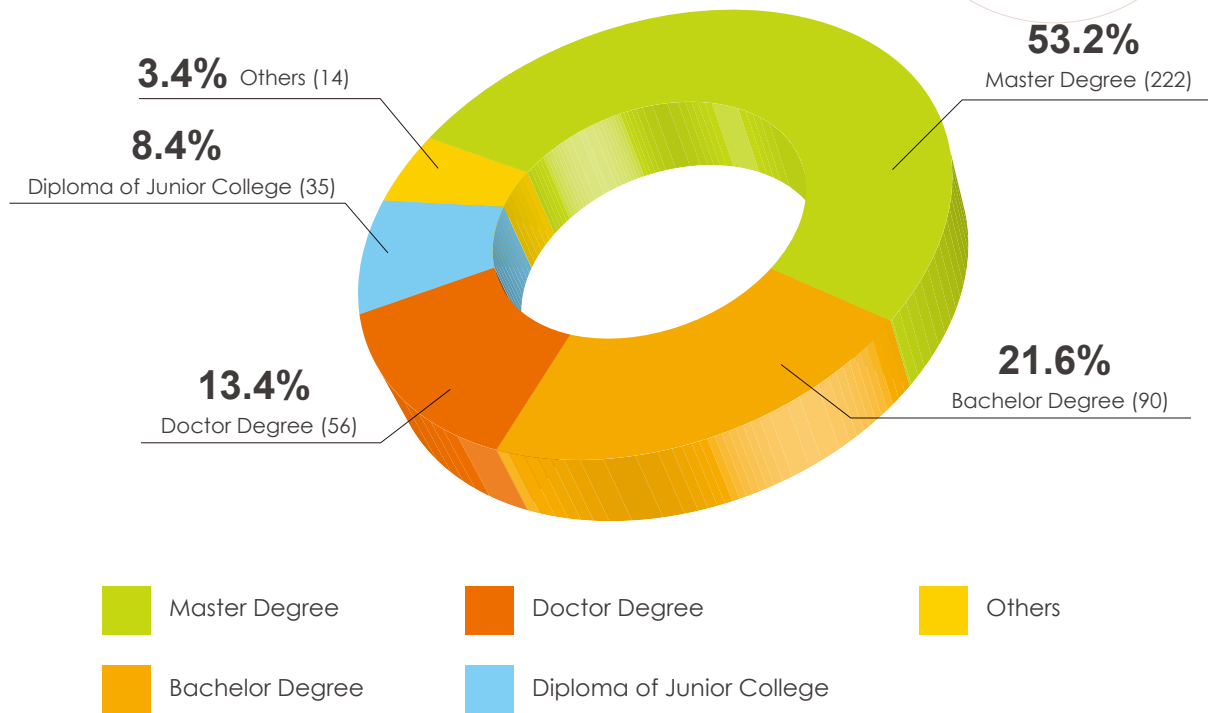
# Organization and Human Resources

## Organization





## Human Resources



**Number of employees: 417**





# Researches on Products and Process



## Optimization and Value-addition of Agriculture and Livestock Products

### Scallion Savory Fillings

Recipe, processing condition and quality specification of scallion savory fillings product were set up by formula and drying processing technologies. The fillings maintain good quality when stored in frozen condition for 30 days, and may be applied to multiple products to develop snack products with healthy claims or with distinguishing features and culture image.

### Flammulina velutipes Drink Product

The drink product was made of *Flammulina velutipes* using high pressure homogenizing technology, which was rich in soluble total polysaccharides. We also established the manufacturing process and the quality indicators of the drink product. It was the first domestic drink product of *F. velutipes*. This technology has been transferred to the industry and the products have been commercialized.

### Powdered Calcium Products from Livestock and Poultry Bones

Using organic acid solution, the livestock and poultry bones are autoclaved, high speed homogenized and freeze dried to develop high quality powdered calcium products with a calcium content of 5~13%. The impact of processing on calcium bioavailability was assessed.

## Application and Development of Ginger Protease

The ginger protease solution and powder were made from local grown ginger by filtration, extraction and drying processing technologies. Ginger protease rich in ginger flavor possess milk clotting and antioxidant activities which could be applied in milk clotting products and meat tenderization.

### High Quality Dried Fruit Products

FIRDI used pineapples and mangoes to produce dried fruits by microwave assisted hot air drying. This process can shorten the drying time by 90% compared to that of the traditional hot air drying. The end products are of high quality. The drying process has potential for commercialization.

## Development of Functional Drinks

### Micronized Formula Technology of Supplemental Drinks

The technology is aimed at the interaction of different proteins in supplemental drinks through assessing the physical properties of the proteins, such as viscosity, particle size, osmolality and pH. FIRDI integrated micronized technology to establish the formula-physical-quality model. The technology can not only significantly improve formulation stability but also assist individual manufactures to develop different formula compositions and shorten product development time.





Xylooligosaccharides with low degree of polymerization

Taro crispy cake

Dried pineapples and mangoes

## Commercial Processing Technology of Functional Foods

The Chayi Industry Innovation Center (CIIC) applied the fast prototype platform of health drinks to provide the commercial processing or technical services for functional products. In the meantime, CIIC introduced the product quality and safety assessment, the export application and other integrated services. This year we applied functional materials with the southern regional characteristics (e.g. *Auricularia auricula-judae*) to establish the raw material processing and preservation techniques and combined with commercial processing. We also introduced the processing technologies (e.g. miniaturization, high pressure homogenization etc.) according to the needs of variety of products. We even introduced the microwave-assisted drying processing and other innovative technologies to improve or advance the existing process.

## The Quality Assessment Techniques of Liquid Functional Food Products

We applied the predicted kinetic models and verification platforms to explore the retention of functional ingredients after thermal processing and storage for the quality assessment of liquid functional food products. We also integrated the technology for the health food development and commercialization and provided the R&D service platform to assist the industries in developing quickly health functional food products with high nutritional value and distinguishing feature.

## Processing Technology for Preparation of Xylooligosaccharides with Low Degree of Polymerization

The purpose of this study was to extract pentosan from lignocellulose materials, such as wheat bran, corncobs, sugar cane bagasse, and applied steam explosion, enzyme hydrolysis, and ultra-filtration to produce xylooligosaccharides. The effect

of each of these xylooligosaccharides products on the growth of probiotics was evaluated by SD rat model. The growth of probiotics obtained from the rat fed with the products for 6 weeks were better than that of control. This technology can assist manufactures to develop functional beverages products with low DP xylooligosaccharides.

## Texture Improvement Technology and Sensory Evaluation of Elderly Food

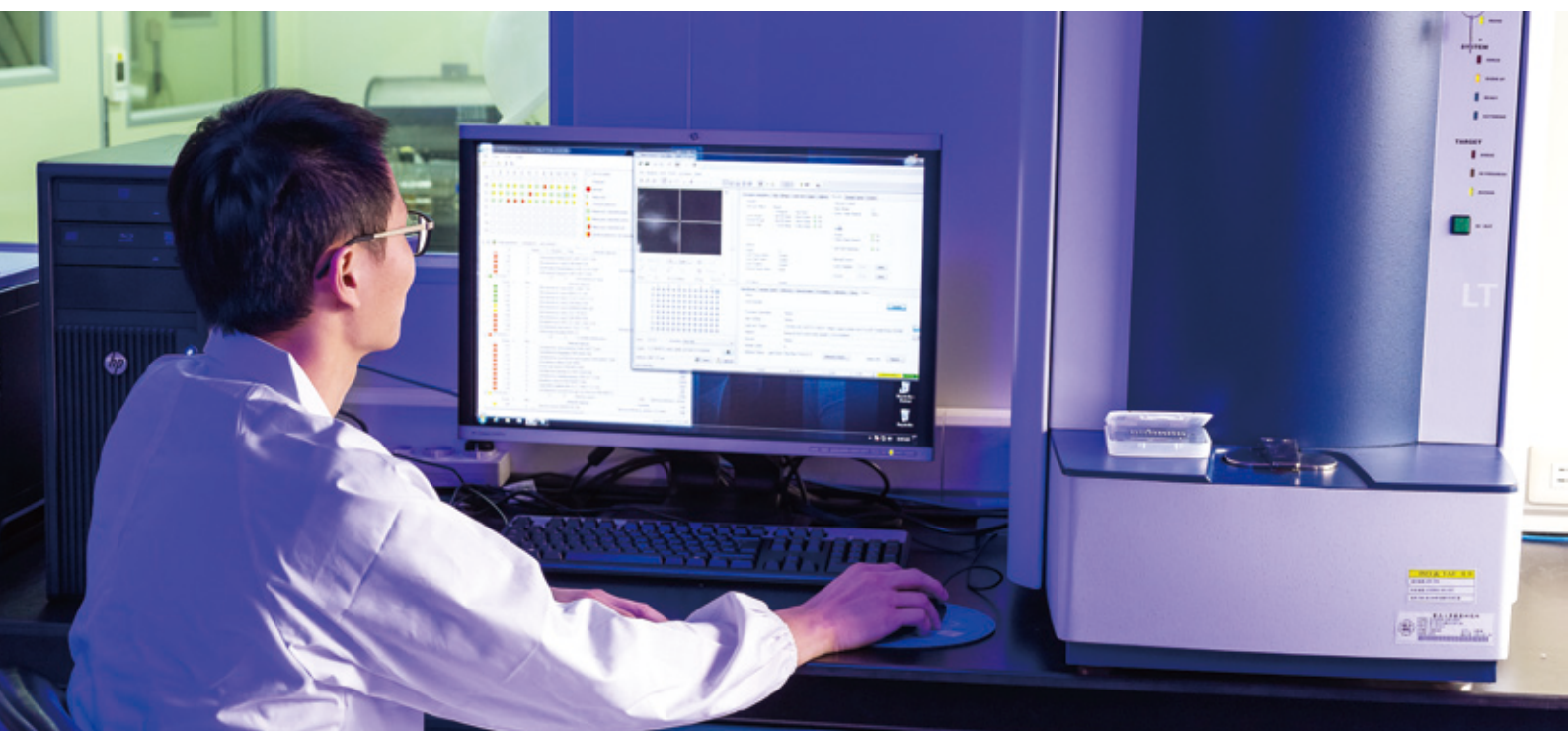
Traditional rice snack foods (salty rice pudding, rice tube pudding, and Taiwanese meatballs) were used as demonstration examples for the texture analysis and sensory evaluation methods to develop elderly foods. The formula was improved and combined with well nutrition design to keep soft texture of traditional snack foods after refrigeration or freeze preservation. At the same time, the food hygiene control for processing of elderly foods was also established. The relevant parameters of elderly foods have been integrated by texture analyzer and sensory evaluation test. This will contribute to the successful development of elderly food products.

## The Hurdle Technology of Extending the Shelf Life of Bakery Products

Due to popular souvenirs purchasing of tourists, the aim of this study was to extend the shelf life of bakery products to improve convenience of market circulation of such products. To replace preservatives and improve the overall quality of bakery products, the hurdle technology was applied on taro crispy cakes as the example. FIRDI inhibited the microbial growth by combing the water activity control, product formulation design, process optimization, and product package. The shelf life of taro crispy cakes was extended by 40% more while keeping good flavor quality.



# Value Addition of Bioresources



MALDI-TOF MS System

## Collection and Distribution of Bioresources

### Bioresources Services

Bioresource Collection and Research Center (BCRC) is the world's tenth largest/Asia's largest biological resources center. BCRC provides a wide range of bioresources, strain information and related services. In addition to the bioresources, BCRC has established more than 160 testing services to industry and provided professional assistance about the domestic or international bioresources related laws and regulations to the research community. In 2014, BCRC has provided 5,081 batches of bioresources and over 2,000 services (including identification, testing, storage, and introduction of biological materials and personnel technical training, etc.) to the industry. At the end of this year, the total collection of BCRC was over 28,068 microbial strains, 19,688 cell lines, and 1,200,000 genetic resources of selected clones. BCRC continued the operation and management of the remote offsite backup system in Chiayi and has set up the SOP for bank management. BCRC has planned to simultaneous storage configuration management of biological materials and related information in Hsinchu and Chiayi to keep the preservation of the collected bioresources from natural or other risks.

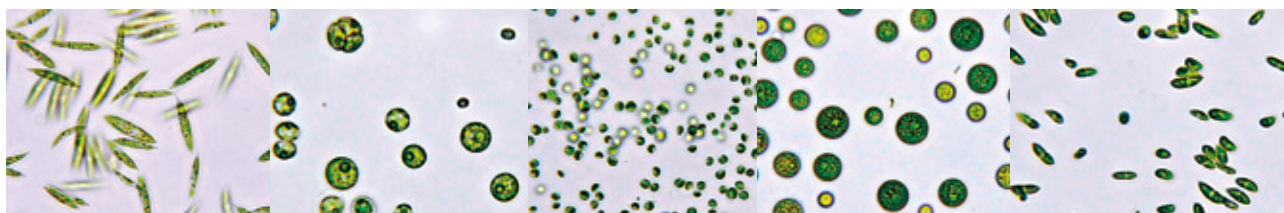
### Adjustment of Policy for Deposit and Supply of Biological Materials

In July, 2014, the adjustment of policy for deposit and distribution of biological materials was announced. For material

supply, to be consistent with practices of global culture collections, materials supplied by BCRC in general may be used for research purposes only. For material deposit, three options are available for deposit of publically available materials. Options are differentiated by the scope of use for recipients of the deposited material, namely, research use only, available for commercial use (BCRC Partner program), and other customized conditions. For depositors joining BCRC Partner program, the depositors will be benefit-shared from the recipients for commercial use of the deposited materials. In August, deposit service for biopesticide registration was launched to meet the deposit needs from the biopesticide industry according to the "Guidelines for Deposit of Microorganisms for Microbial Pesticide" enacted by Bureau of Animal and Plant Health Inspection and Quarantine on July 21, 2014.







Local isolated microalgae in BCRC exhibit a rich diversity category

### Customized Services

The industrial service system of BCRC including the bioresources distribution platform has been established with comprehensive bioresources and international leading quality management system for related services to provide certified reference materials and diversified industrial services. This year, BCRC continued the compliance with the ISO 9001 quality certification system to maintain the quality of bioresources. Also, BCRC kept maintaining the TAF accreditation by complying with the ISO/IEC 17025 to be proficient in the testing services and ISO Guide 34 to produce reference materials correctly and competently. In hence, BCRC tried its best, from production planning to management auditing, detection and evaluation, all to meet the customized requirements of biotech industry to develop the global markets.

### Deposit of Biological Material for Patent Purposes

FIRDI has been entrusted by the MOEA as the designated national depository of biological materials for patent application since 1994. The depository is operated in compliance with "Regulations for the Deposit of Biological Material for Patent Application". Upon accepting a deposit, after a viability test for the deposited biological material, the samples are preserved in storerooms, and the related information and the storerooms are under strict control to ensure the safety and confidentiality of the deposited material. Upon issuing a patent to the deposited material, the deposited material can be provided to the public for research purposes. Consultation is also provided through various channels. To improve service satisfaction, the ISO 9001 quality management system has been introduced since 2000. In 2014, the Intellectual Property Office further assured that the depository complied with the requirements of International Depository Authorities (IDAs) as required in article 6(2) of the Budapest Treaty.

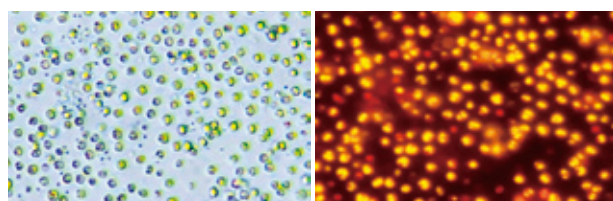
The assurance of FIRDI's compliance to the IDA requirement makes signing of a memorandum by Japan's Association of East Asian Relations (Japan) and Taiwan's Interchange Association Japan possible. The memorandum builds up a cooperative program on mutual recognition of deposit of biological materials between Taiwan and Japan. Upon the implementation of the cooperative program,

applicants can make a single deposit in either Taiwan or Japan for patent filing in both countries.

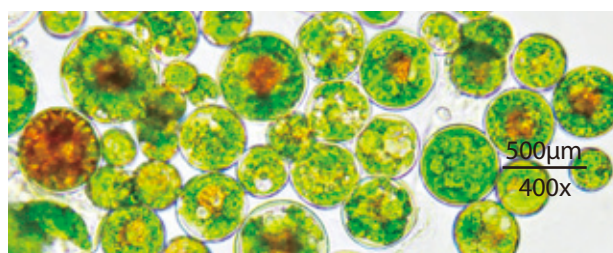
### Expansion of Biological Resources

#### Microalgae Expand the Industrial Application of Bioresources

Microalgae can be applied to different fields, such as the food, biomass, energy, environmental protection and pharmaceutical application. To promote and expand the fundamental study and application of microalgae in Taiwan, BCRC has gradually established the technologies and methods for microalgae separation, purification, storage and identification. This year BCRC established the screening methods and collected the microalgae strains with oil-producing and/or carbon dioxide recycling capacities. Fifty algae species have been listed on the BCRC public catalog, including 16 local microalgal isolates, such as *Monoraphidium* sp. (BCRC AL20002), *Ourococcus multisporus* (BCRC AL20003), *Coelastrella* sp. (BCRC AL20004), *Parachlorella kessleri* (BCRC AL20082) and *Chlorella vulgaris* (BCRC AL20084) and so on. Some local microalgae strains of BCRC showed high lipid content (over than 45%) in cells and/or excellent CO<sub>2</sub> fixation rate around 282 to 655 mg/L/d. BCRC welcome the consultation and application of the microalgae resources from research communities and industries.



Microalgae oil droplets accumulate in the cell (observation by fluorescence microscopy)

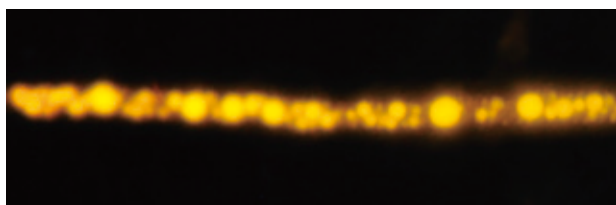


*Haematococcus pluvialis* (BCRC AL20046) has the potential of producing astaxanthin

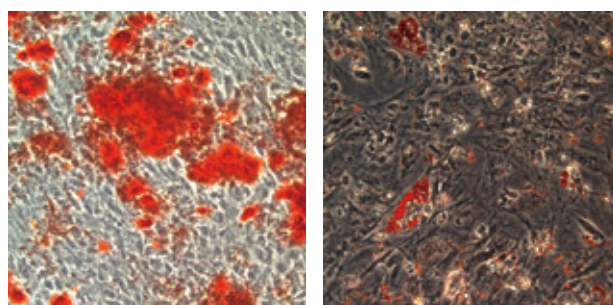
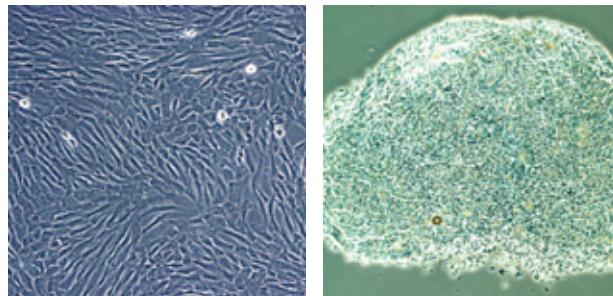
# Value Addition of Bioresources

## Oleaginous Fungal Resource

Fungal oils are of industrial interest for biodiesel and valuable polyunsaturated fatty acids (PUFA) production. The accumulated lipid droplets in fungal mycelia were detected by fluorescence staining to select candidates of oleaginous strains. Combining the information of cell lipids and growth performance, value-added oleaginous fungal resources were constructed. Domestic oleaginous fungal resources are the basis to develop an alternative biodiesel feedstock for multiple energy resources and energy independence.



The accumulated lipid droplets in fungal mycelia were detected by fluorescence staining



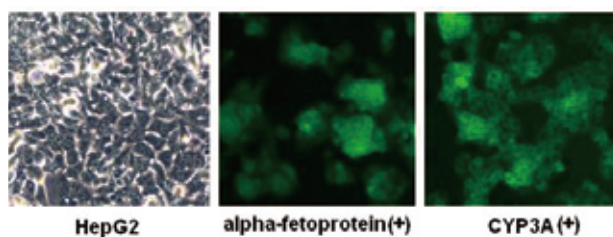
The phenotype and differentiated potentials of WJMSC (BCRC RM60596)

## Reference Materials Producer in Animal Cell Lines

According to the requirements of ISO Guide 34, BCRC now provided NCTC-clone929 (BCRC RM60091), WJMSC (BCRC RM60596) and HepG2 (BCRC RM60025) as the reference materials. These cell lines are well characterized and are ensured in homogeneity and stability. The NCTC-clone929 is specific for cytotoxicity testing in medical devices and food and biomedical products. WJMSC with stable expression of CD73, CD90 and CD105 is a good source of mesenchymal stem cells. HepG2 is an important cell line in drug screening and in studies of liver metabolism and liver cancer. These reference materials will provide global customers with high quality services in animal cell lines.

## Analysis of Standard Operating Procedures of Cord Blood Banking for Recovery of Very Small Embryonic-Like Stem Cells

Recently, various types of stem cells are found in human. Very small embryonic-like stem cells (VSEL stem cells) expressing specific markers of embryonic stem cells are a rare

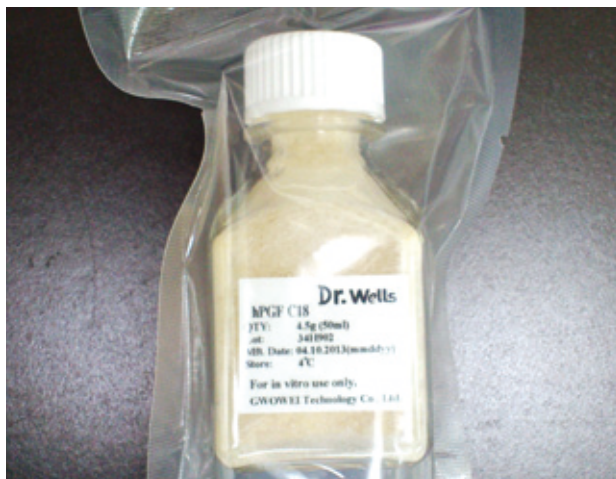


HepG2      alpha-fetoprotein(+)      CYP3A(+)

The phenotype and specific markers of HepG2 (BCRC RM60025)

cell subset with a small size and have the pluripotent potentials. The recovery of VSEL stem cells is affected by different processing procedures. Here, we analyzed the effect of standard operating procedures of cord blood banking on the retention of VSEL stem cells and found the VSEL stem cells were mostly recovered in the final products. This result has been published in *Cytotherapy*, the official journal of International Society for Cellular Therapy (*Cytotherapy* 16(4):560-565, 2014). The report is an important reference for the stem cell banks in business.





Growth factor complex

Microencapsulation of *Lactobacillus* sp.

## Application and Development of Biosources in Industry

### Product Design Platform Using Novel Functional Ingredients and Formulation

A novel functional ingredient was developed from a microorganism collected in BCRC. This year we developed a microbial transformation technology to produce resveratrol and conducted the development and application of native entomogenous fungi. We help small and medium enterprises (SEMs) in technology development and upgrading by producing novel functional ingredients. We also developed new formulation system, including microemulsion, solid lipid nanoparticles, nano-structured lipid carriers, and multiple emulsion systems to increase the biostability and bioavailability of hydrophobic ingredient. We helped some SEMs to develop new products, production process, and fermentation technology with the product design platform.

### Development of Hypouricemic Products Using GRAS Microorganisms

Hyperuricemic patients are increasing globally. However, the current hypouricemic medicines are rare and have some intrinsic problems, such as side effects and single mechanism. A better antihyperuricemic product is urgently needed. In this project, we have obtained two types of strains with antihyperuricemic effect from GRAS microorganisms. They can reduce urate production by inhibiting xanthine oxidase (XO), a key enzyme of uric acid biosynthesis, or producing uricase to digest uric acid. In this year, we established the fermentation processes of AHU01 (the producer of xanthine oxidase inhibitor) and UA120 (the uricase producer) and confirmed their function by animal tests. The strains could be developed into novel hypouricemic products in the future.



# Development of Emerging Food Technologies

## Novel Sterilization Technology

FIRDI used the pulsed light equipment and high hydrostatic pressure equipment of laboratory scale to investigate the sterilization effectiveness of food indicator pathogens. The kinetic parameters for sterilization pathogenic strains under different processing conditions have been studied to establish security verification platform of various sterilization techniques. This platform can be used as the basis of hygiene and safety for product development of food industry.

### Application of Pulsed Light Technology on Cap Sterilization

Due to the limitation of irradiation only for broad area with unstable overall sterilization efficiency for solid containers at present stage, the pulsed light was given priority to the sterilization of caps. The sterilization efficiency of index spores inoculated in containers achieved 5 LCR by combining pulsed light with chemical sterilization procedure under the following conditions: pulse light intensity  $> 0.5 \text{ J/cm}^2$  and flash frequency  $> 3$  pulses/sec. The efficacy of pulsed light for shelf-life extension, estimate equation and validation can be established step by step by investigating irradiation doses of pulsed light modules and inactivation of bacteria on packing material surfaces. The pulsed light technology can be extended to apply on liquid aseptic filling system and key components for package sterilization to improve the design and analysis abilities of domestic liquid food mechanical industries.

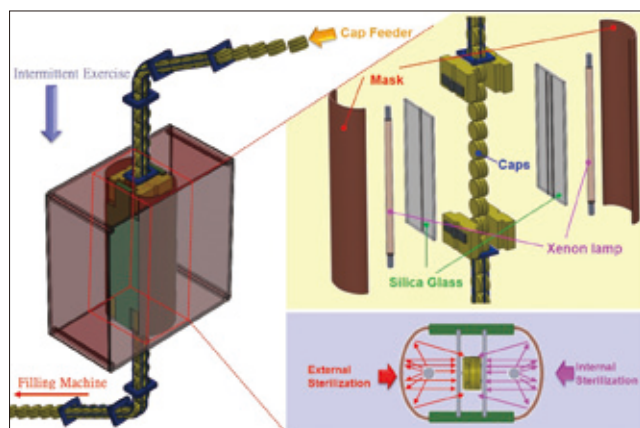
### Continuous Pulsed Electric Field Pasteurization Process

Pulsed electric field (PEF) pasteurization technology is an emerging non-thermal technology, mainly used in vegetable

and fruit juices processing. It has the advantage of continuous production and retention of fresh flavor and nutritional value. FIRDI conducted an interdisciplinary cooperative project with the National Chung-Shan Institute of Science & Technology for development of PEF pasteurization system and process. The developed continuous PEF system has technical parameters of the pulsed electric field strength 30-60 kV/cm, pulses width 1-2  $\mu\text{s}$ , frequency 1-10 Hz, and temperature range 10-50°C. In production capacity of 50 liters per hour of passion fruit and lychee nectar, the pasteurization process reached 4 log reductions in viable microorganisms. This novel processing technology could be used to produce heat-sensitive vegetable and fruit juice and has the potential of upgrading non-thermal processing technology of domestic beverage industry.

### High Pressure Pasteurization of Custard Apple Puree

Custard apple is an important fruit in eastern region of Taiwan. Thermal processing of custard apple causes loss of fresh flavor and formation of bitter taste. High pressure processing allows the development of custard apple puree with fresh-like flavor and extending the shelf life of the product. This study established an automatic processing line and the high pressure pasteurization process for custard apple puree. The challenge test of the high pressure pasteurization with *Listeria innocua* achieved a log reduction of 6.7. The high pressure processed custard apple puree had a shelf life of 21 days at 7°C. The viable count was less than  $1.0 \times 10^1 \text{ CFU/g}$  at the end of shelf life. *E. coli* and coliform were less than 3 MPN/g. The overall acceptance, texture, taste and flavor of the products from different production regions were more than 5 points upon evaluation.



The design and verification techniques of cap sterilization system with pulsed-light



High pressure processed custard apple puree



## Integration of Filtration Sterilization Technology for Heat-labile Functional Ingredients and Aseptic Dosing Process Technology

This study was to establish the equipment for liquid sterilization with membrane filtration method and integrate with aseptic dosing process technology. Through system verification, the sterilizing efficiency of the membrane filtration equipment can reach  $10^7$  CFU/cm<sup>2</sup> reduction of *Pseudomonas diminuta* ATCC 19146. The equipment was applied to the sterilization of two heat-labile functional ingredients, pineapple enzymes and lactoferrin, with a total microbial content of  $2 \times 10^6$  CFU. With a parameter of system maximum flow of 66 L/hr and deployment volume of 10 L, the product achieved aseptic state with higher than 90% retention of the pineapple enzymes and lactoferrin contents. This process technology can be used as new processing methods for heat-labile functional ingredients added to the beverage.



Membrane filtration sterilization equipment

## High Efficiency Extraction Technology

### Ultrasonic Assisted Microwave Extraction Technology

Combination extraction technology was developed by using ultrasonic assisted microwave or ultrasonic assisted enzyme complex extraction. These techniques can significantly increase the yield of target compounds or reduce the process time and temperature. With the same process conditions, the amount of polysaccharides extracted from *Ganoderma lucidum* by using ultrasonic assisted microwave extraction was more than 3-folds compared with hot water extraction and equal to microwave extraction, but the final temperature was lower about 20°C. Ultrasonic assisted microwave extraction also can increase the yield of *Panax ginseng* polysaccharides by 4.6 and 1.7 folds compared with hot water and microwave extraction, respectively. The amount of polysaccharides was equal to hot water extraction for 6 hr.

### Ultrasonic Assisted Mixture Enzyme Complex Extraction Technology

Ultrasound technology was used to assist mixture enzyme in extracting peptides from the poultry, beef and antler. This technology reduced the addition of enzymes by 40% with higher peptide yield. The content of total peptides and short peptides (< 3 KDa) were 10 times higher than those of traditional extraction by high temperature and pressure for a long time.



Ultrasonic assisted microwave extraction test equipment



# Guidance of Local Food Industry



Chiayi Industry Innovation and Research Center, MOEA

## Operating Chiayi Industry Innovation and Research Center, MOEA (CIIC)

The Ministry of Economic Affairs (MOEA) has assigned the Food Industry Research and Development Institute (FIRDI) to operate the administration and research functions of the CIIC since 2011. We expect to promote the CIIC as the benchmark for innovation and as a health-oriented technology investment/application center by integrating resources of industries, government, the academia and research institutes in Southern Taiwan.

### Assisting Local Business with Innovative Research and Integrated Services

Executing "Counseling seminars of governmental programs for encouraging firms' innovative research" and "Plan-writing gifted classes" for firms to enhance understanding of government firm-guiding resources. We assisted the firms counseled by the Chiayi specialists of schools and research institutes to apply for government research grants program to reach technical upgrading and transformation. We visited local firms actively and expanded visiting range in Chiayi, Yunlin and Tainan industrial parks. In 2014, we visited 388 firms 779 times. To satisfy firms' demands, 18 firms have become business tenants in CIIC. There were also 43 conferences and training courses held, providing 1,862 attendees with professional knowledge. Furthermore, the Food Safety Inspection Center established in 2011 has provided 58 firms with a more convenient and faster inspection service for the local food industry. Additionally, the eight research communities formed by the research institutes in CIIC has held 25 forums on specific related subjects, expecting to stimulate innovative ideas and cooperation opportunities through interacting with each other within these knowledge-sharing platforms.

## Integrating Institutes to Promote Innovation of Industrial Technology

To promote the demand-planning of local characteristic industries, we have integrated the four research institutes in CIIC and constructed cross-cooperation model on the basis of health food commercialization R&D service platform. In 2014, a cooperation project on "wood ear (jelly ear) industry value chain" was performed and promoted the formation of the R & D community of wood ear. We also promoted the formation of the "R & D alliances of wood ear liquid and dry materials" and assisted the alliances to apply central government R&D subsidies. Also, CIIC was entrusted by Chiayi City Government to handle the Local Small Business Innovation Research program (Local SBIR) from 2012. We further extended our service to the local SBIR program of Yunlin County in 2013 and Chiayi in 2014. CIIC plays the communication channel between government and enterprises to achieve good reputation. There were 29 cases advised by CIIC research institutes to apply Chiayi county/city and Yunlin County local SBIR and 21 cases approved in recent three years. CIIC has also assisted 21 cases of the local businesses to obtain central/local government R&D subsidies in 2014.

### Promoting the Academia and Institutes Cooperation to Serve Local Industry

We constructed and operated the Research Resource Integration and Service Platform website to promote cross-sector cooperation and alliances among platform members by integrating resources of the academia and research institutes in Chiayi/ Yunlin. In 2014, CIIC coordinated with "Office for promoting cooperation among industries, government, the academia and research institutes" of Douliu Industrial Park Service Center, MOEAIDB to conduct special lectures for firms.



We were accompanied by Southern Industry Service Division of Industries Assistance Center, MOEA to visit firms in Southern Industrial Parks, and visited firms in Chiayi/Yunlin with Chiayi SME Service Volunteer Association. "Care plan of SMEs in Yunlin County" was implemented in 2014 to expand and extend the service tentacles of CIIC into various industry clusters in the region. In addition, we continued the cooperation with "Bridging Academia and Business-management Research Center" of College of Management at National Chung Cheng University to handle the "2014 Operating entrepreneurial experience-knock sharing (third)" forum to drive operative innovation for local industries.

## Local Food Industrial Improvements and Transformation

### Counseling for Upgrading the Food Processing Industry

In 2009, in an attempt to aid in the innovation and upgrading of traditional food industries, FIRDI coordinated with government policies to establish the "Food Processing Industry Upgrading Counseling Team", which gave preferential care to the main agricultural counties of South Central Taiwan, including Yunlin, Taichung, Changhua, Nantou and Chiayi. The team further expanded its scope of guidance to all of Taiwan due to the influence of trade liberalization in 2010 to focus on small and medium enterprises of the food industry in the domestic market and emerging biotechnology companies, as well as assisted in the promotion of industrial competitiveness. As of the end of 2014, the team assisted more than 850 factories in applying for governmental subsidy plans or project counseling and promoted more than NT\$ 5 billion of manufacturer investments with an output increase of NT\$ 10 billion. The team effectively aided manufacturers in improving their processes and encouraged new product development and research energy.

### Upgrading and Innovation of the Offshore Food Industries

**Kinmen:** I-Tiao-Gung (*Glycine tomentella* Hayata) is one of Kinmen specialties. It is an important task to enhance Kinmen I-Tiao-Gung's value and industry. FIRDI helped the establishment

of R&D alliances for Kinmen I-Tiao-Gung. The micro-size particle milling technology was applied to Kinmen I-Tiao-Gung to form tea bag-type products. Then brewing the tea bag filling with fine fragment could release about 2-fold more function substances than that filling with conventional coarse fragment. The animal experiments showed that drinking 6 g of Kinmen I-Tiao-Gung brew tea a day could regulate the level of serum triglycerides and low-density lipoprotein cholesterol. Daidzin was an important reference standard of Kinmen I-Tiao-Gung brew tea. The R&D alliances also helped each develop Kinmen I-Tiao-Gung and herbs mixed products which showed unique characteristics of each component and the function of lipid regulation.

**Mazu:** FIRDI organized the Mazu industry R&D alliance focusing on the improvement of Mazu's old wine, red vinasse and kaoliang wine industry chain. Mazu alliance invested new equipment and technologies for the improvement of red koji, white koji and sorghum koji production, and developed multiple type souvenirs, such as Red vinasse sauce, Kaoliang vinegar, Hong-Zao fish, Hong-Zao egg rolls and Hong-Zao facial mask. Moreover, the alliance simplified the manufacture process of Mazu old wine and Hong-Zao facial mask as DIY tours, which have obtained the Mazu Characteristics Tours Award. It is noteworthy that during the counseling of BCRC, their products have been displayed on the shelf of Far Eastern A-Mart and Dian Shui Lou, a famous restaurant. In 2014, we continued counseling the innovation of Hong-Zao products. For example, the features of red vinasse, such as the food preservation and rich-functional ingredients, have been used in the development of "low-sodium Hong-Zao bean curd".

**Penghu:** Penghu cactus has been developed into products such as ice creams, jams, vinegars, mochi, pastries, jellies, bakery, and wine. However, some problems have been found in these products, including inconsistency in cactus fruit quality, hygiene consideration of cactus juice without pasteurization and color change of processed products during shelf life. These problems were resolved by incorporating key technologies of FIRDI and cooperating with Taiwan fruit juice processing companies to establish optimal formulation and packaging technology to assist the cactus industry in Penghu.



Micro-size particle milling of Kinmen I-Tiao-Gung



Hong-Zao facial mask

Kaoliang vinegar



# Industrial Services



## Certification and Accreditation of Food Quality Control

### The Promotion of the CAS Food System

FIRDI aids the Council of Agriculture in promoting its agricultural certification system, which mainly includes the following 11 items: local raw material-based frozen foods, juice, pickled fruits & vegetables, rice, ready-to-serve meals, refrigerated prepared foods, fresh edible mushrooms, fermented foods, snack foods, cut-down fruits and vegetables and aquatic products. In 2014, Taiwan Premium Agricultural Products (CAS label) accreditation was carried out at 176 factories with 478 follow-up inspections and sample testing on 714 products. Furthermore, the sampling of hazardous substances from raw materials (including animal drugs, pesticides, etc.) was strengthened with 186 samples of raw materials being tested. FIRDI also assisted in improving problematic products and process technology.

### Food GMP Certification System

FIRDI is assisting the Industrial Development Bureau, MOEA in promoting food's Good Manufacturing Practice (GMP) certification system. The food safety control system and traceability management requirements were added this year to improve the management of raw materials and additives, while continued to support the implementation and assessment of verification operations related to food production chain in order to provide relevant consulting diagnostic services. At the request of food industry practitioners, we began developing functional food quality specification benchmarks. Moreover, regular tracking and product sampling test help to strengthen a practitioner's independent managing ability and improve food

GMP system implementation level. The domestic food industry has already passed 4,044 certified products from 430 different factories.

### Hazard Analysis and Critical Control Points (HACCP)

**Dining:** In 2014, FIRDI worked with the county and city department of health to check the conformity of 67 lunch box food factories and advised 22 of them to track their management system methods. The information of 938 food material suppliers was added. We instructed six food suppliers to establish GHP documents and two food material suppliers to establish food safety control system documents. We even assisted the upper echelon of the food and beverage industry to protect against food hazards. We also made 91 health evaluations of food practitioners, checking 10 popular tourist restaurants and medical institutions 10 times each. Furthermore, we developed and published the "Catering Hazard Analysis Critical Control Points (HACCP) Appraisal Consistency Clearing Manual", as well as the second edition of the "Catering Food Materials Analysis Reference Manual", and further created the "Catering Pest Control Reference Manual" as a reference for catering business HACCP implementation.

**Canned Foods:** In addition to the constantly strengthened tracking of the original cannery and the tracking coach of the new cannery, we also investigated and developed a manufacturer database for products at high risk that have been just recently included in the application of canned goods' hygiene practices, and then aided dealers in complying with relevant regulations. Furthermore, we held a meeting of the "Regulations for Food Exported to the US" in order to help relevant manufacturers to comply with such regulations. For



the Food and Drug Administration, Ministry of Health and Welfare (TFDA), as well as various health authorities' employees, we initiated the "Cannery Inspection and Management" course to increase the knowledge of inspection techniques of new staff members. FIRDI is the only authorized sterilization organization of the Agency for TFDA and the U.S. Food and Drug Administration (FDA) in Taiwan. Over the course of this year, we assisted in 18 systems functional tests of the continuous flow production line and evaluated the sterilization value of 386 sterilization products and 52 exported canned goods, while performed 67 retorting thermal uniformity tests and 778 market canned goods sterilization condition heat penetration tests. We also advised three low-acidity hot fill PET bottle canneries in complying with the food safety control system.

**Dairy Products:** According to the auditing results of the implementation of HACCP system in dairy factories of 2013, FIRDI helped 34 dairy production lines to improve the food safety management system in 2014. Furthermore, FIRDI helped county and city department of health to guide dairy factories to establish HACCP plan and audit dairy industry practitioners. To meet the food safety management system database uploading regulation of the Food and Drug Administration, Ministry of Health and Welfare, FIRDI was able to upload 36 dairy factory counseling results in 2014 as a reference for county and city health department for the purpose of audit counseling. FIRDI also held various training programs for the dairy product manufacturers.

**Aquatic Products:** This year we aided in the auditing and classification of 134 aquatic products manufacturers (including canned seafood products, refrigerated seafood, dry seafood seasoning products and other aquatic products). We also performed a market sale item investigation and created a hygiene safety analysis report, as well as held both general and HACCP grading expert meetings.

### Alcohol Product Certification System

FIRDI continued to implement the National Treasury Administration, Ministry of Finance's wine certification system this year, performing 46 certified wine factory lines and 179 sessions of tracking inspection work, in addition to the sampling of 447 wine varieties. FIRDI further revised two assessment benchmark drafts for distilled liquors made from sorghum, rice, or sorghum and other grains and aided 37 manufacturers in taking part in 85 certification sessions. Furthermore, four plants passed certification review and received certification for 13 new products. Three wine manufacturers' technical training courses were held and the survey report regarding high-alcohol liquor plasticizer was completed.

### Management and Quality Improvement of Vacuum-packed Foods

In 2014, FIRDI aided the Food and Drug Administration, Ministry of Health and Welfare in reviewing 13 cases of vacuum-packed instant soybeans, as well as helped four vacuum-packing manufacturers implement "sanitation



The livestock processing products traceability system is being introduced to the public in the Hsinchu Meatball Festival on October 19, 2014

regulations for vacuum-packed foods " and " labeling standards for vacuum-packed foods on the market ". Furthermore, FIRDI tracked, inspected, and registered 12 manufacturers 12 times each and sampled 138 market vacuum-packed food items (inspection registration of 38 pieces and non-inspection registration of 100 pieces). FIRDI also sampled and checked 75 market vacuum-packed food items of 40 registered pieces and 35 nonregistered pieces.

### Hygiene and Safety Management Verification Reviews (the Edible Oil Manufacturing Industry)

This year FIRDI aided the Food and Drug Administration, Ministry of Health and Welfare in verifying edible oil manufacturing operations and determining whether the industry complied with current Good Hygienic Practice (GHP), login operations, first grade quality control and job tracking. FIRDI reviewed 23 edible oil manufacturing validation operations of 31 plants to determine whether the jobs and health and safety requirements complied with regulatory requirements.

### Processed Food Traceability System

#### Constructing the Traceability System of Livestock Processed

**Products:** FIRDI established a traceability system of livestock processed products network and aided the Council of Agriculture (COA) in setting up the following: livestock processed product traceability, guided meatballs industry (including two slaughter and cutting plants and eight manufacturers), chicken essence industry (including one slaughter and cutting plant and two manufacturers) and century eggs industry in order to establish production traceability. Livestock production traceability website (<http://lppts.firdi.org.tw>) was established by FIRDI. For the safety of the meatball products, Hsinchu City Government declared 2014 to be the first Hsinchu meatball traceability production year on October 19, 2014.

#### Implementation and Guidance of the Processed Food Traceability System:

In accordance with the "Food and Related Product Tracking and Traceability System for Food Industry Practitioners", FIRDI helped 203 manufacturers with the development, processing and establishment of food traceability

# Industrial Services

systems that contain the key words of edible oils and fats, meat processed foods, dairy products, fish foods and "Non-GMO" labeling. We also aided food manufacturing, processing and seasoning manufacturers in establishing tracking and tracing systems, assisting five of them to join and upload the "must track" platform. Furthermore, we invited experts and scholars to a meeting to discuss their doubts regarding the implementation of the tracking and tracing approach. A workshop for local health authorities was held to improve auditors' skills. Convened conferences were also held to help practitioners to establish 16 food traceability templates so that employers can develop a traceability tracking system reference.

**Promotion of CAS Quality Production Traceability:** We aided Council of Agriculture (COA) in helping quality production operators to establish product traceability and upload the information to the "Taiwan Premium Agricultural Products Portal Site" to make CAS product certification information available to both certification units and the consumer end. Throughout this year, we visited 46 plants and uploaded 2,990 pieces of information. With this platform, our goal is to implement and strengthen relevant raw materials management in traceability, verification and information of production batches.

## Risk Management and Control Technology for Raw Materials

We aided manufacturers in developing material information control, as well as technology for raw materials and product quality self-management monitoring. The development and monitoring technology has been established via risk analysis and test projects to reduce food safety issues caused by raw material quality or improper processing or product storage of such raw materials. The project in this year focused on edible oil industry. Peanuts and their related products were therefore selected as the major target for studying on risk management of aflatoxin contamination or oil oxidation due to improper material selection, monitoring and processing.

## Advanced Improvement of Prepared Food Industry

We found out the problems and technological bottlenecks of prepared food industry by the consulting service and introduced core processing technology based on their needs (e.g. hurdle technology, thermal processing, vacuum packing techniques). In addition, we helped prepared food industry to set up the tracking and tracing management of food processing and the rapid monitoring technology of food safety for animal drug residues and microbes to strengthen the self-regulating competence of prepared food industry.

## Optimization of Management and Guidance for Food Factory Raw Materials

We aided food plants in establishing raw material management systems, including systems for inspection operation and supplier management. We also helped them to conduct drug residue and heavy metal monitoring through sampling of common raw materials. We proposed the analysis on possible raw material hazards and strengthened the risk management concepts to improve raw material control and the safety of raw materials on the market.

## Guidance Regarding Food Good Hygiene Practices for Food Factories

Throughout this year, we aided domestic food factory registrants in promoting independent food industry management. We helped food factories that have more than 50 persons in their operations to establish GHP and implement self-management. We further promoted food sales by reacting to internationalization and planning and promoting the international connecting operations in verification systems. In accordance with industrial needs and training courses, we assisted the food industry in establishing and implementing GHP norms and process management. Once compliance with the relevant laws and regulations was confirmed, we advised food plant operations to meet the job requirements and has carried out confirmation and guidance in the plant more than 20 times.

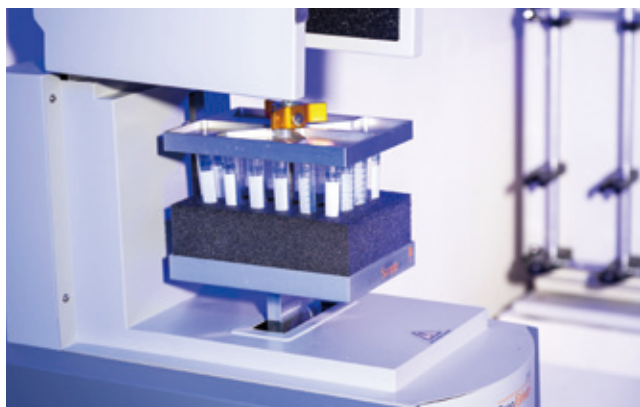
## Standardization of Industry-specific Process

We aided the Industrial Development Bureau, Ministry of Economic Affairs in determining plant standards for additional burden clauses and food plants and confirmed the operations of specific industries. Edible oil, food additives and other upstream raw chemical materials, as well as upstream chemical plants and temporary plant registration certification were selected this year. Of the 354 plants, the main problem consisted of production



High performance liquid chromatography tandem inductively coupled plasma mass spectrometer





Nitrogen dryer

Spectra with stable isotope analysis  
(carbon, hydrogen, oxygen)

process management and plant environment management. We provided help to competent authorities to promote job-related guidance by considering food hygiene, safety, quality assurance and management. Furthermore, the operation of food additive plants was strengthened by establishing a complete management system as well as tracking and tracing systems.

### ISO 22000 Certification Services

ISO 22000 has created the principal requirements for food safety management systems and has become recognized by international food manufacturers worldwide. Compared with ISO9001 and ISO22000, this food safety management system has also added HACCP and food traceability requirements, becoming the standard for global food safety management system certification. FIRDI received Taiwan Accreditation Foundation (TAF) certification and officially became a verification agency for food safety management systems in 1999. The institute's verification range currently covers the majority of food manufacturing industries and has expanded its validation services to food industry chain manufacturing and processing practitioners. There are currently 24 verified practitioners.

## Food Safety Assessment and Inspection

### Analysis Services

FIRDI's Analysis Research and Service Center is a comprehensive food inspection unit that passed the ISO17025 and won recognition for more than 30 inspection items of the Ministry of Health and Welfare and more than 300 TAF inspection items. FIRDI is also a certified laboratory for the Ministry of Finance's tobacco and health standards, as well as the testing unit for Taiwan's export of non-alcoholic beverages such as vinegar, wine, etc. recognized by Brazil customs. To effectively serve the industry, FIRDI actively continues to learn about government requirements and collect relevant technical information in order to not only improve its existing test items, but also develop new test items. In addition to the general and specific analysis of food ingredients, our food adulteration identification and rice grade identification services are unique

in Taiwan. In accordance with the third food safety control of the Food Safety Law and the Executive Yuan, FIRDI can aid manufacturers with the inspection requirements derived from food industry self-management (first-level quality control).

New testing services added this year include: purity or specification of food additives, Dithiocarbamate, dairy hormones, dairy pesticides, inorganic arsenic, etc. Furthermore, based on the amended test items announced by the Ministry of Health and Welfare, the testing of food plant ingredients (qualitative test of garlic, leeks, shallots, onions), food allergens (crab, mango, peanuts, milk, eggs and duck), cholera vibrio and pathogenic *E. coli* were also included. The intestinal bacteria test was newly added according to what is set forth in ISO21528-2:2004. The element analyzer isotope ratio mass spectrometer (EA-IRMS), the gas chromatography-ion mobility spectrum analyzer (GC-IMS) and other equipments used to stabilize isotope and volatile components on the contour map have now increased the economic value of our food adulteration identification service.

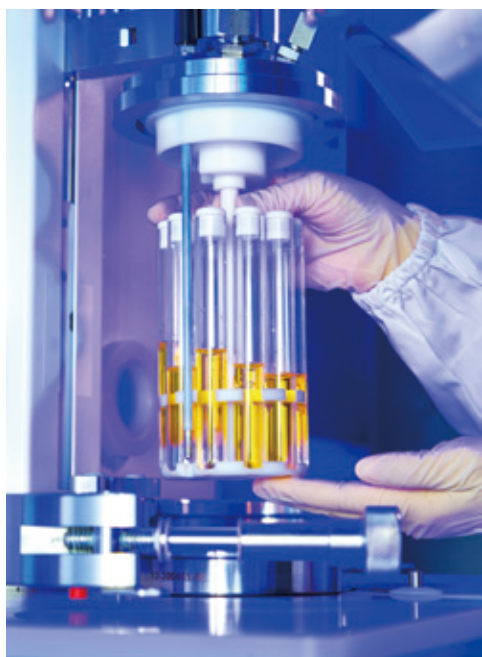
### Analysis of Food Additives

FIRDI aided the Agency of Food and Drug Administration in analyzing food and food additives to determine whether their specifications complied with regulations or not to implement the safe management of additive use. We performed analysis on about 600 items, carrying out 30 maleic acid analyses. Furthermore, our blind sample specimen analysis was completed and passed the Agency of Food and Drug Administration's inspection.

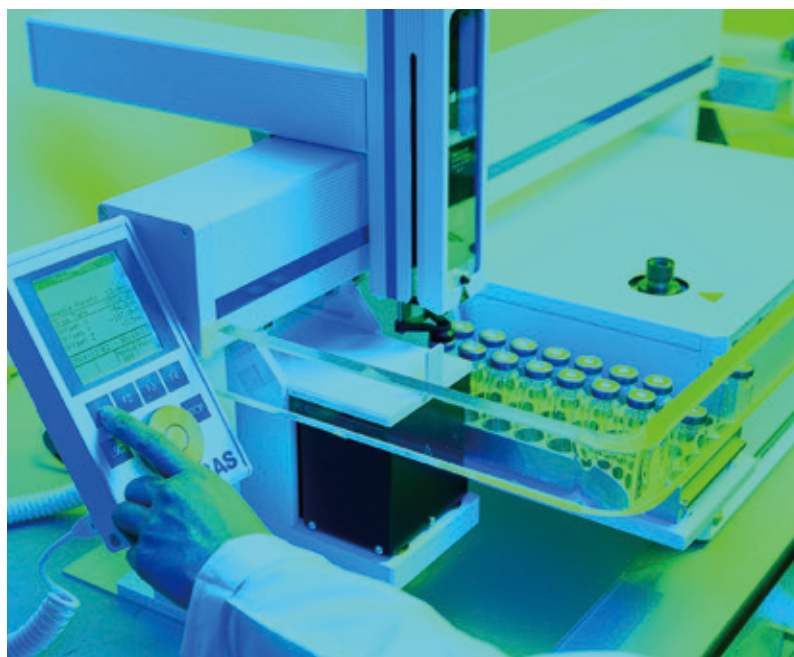
### Database on Food Safety Risk Assessment

FIRDI has aided the Agency of Food and Drug Administration in establishing the knowledge management database of food safety risk assessments to serve as scientific evidence for health risk assessments and the communication of risks since 1995. We updated 100 items of data after expert assessment and added 50 new items of data. In addition to enhancing the convenience of database retrieval and the accuracy of chemical substance identification, we added the Chemical Abstract Service Number (CAS No.) query system this year.

# Industrial Services



Microwave digestion apparatus for checking inorganic elements



Analysis of volatile component

## Market Monitoring of Special Nutrients

FIRDI aided the Agency of Food and Drug Administration in making nutritional labels and investigating health quality. This year we sampled 100 pieces, including 35 baby formula food items, 20 pieces of older baby assistant food and 45 pieces of disease-specific baby food. Monitoring results revealed that product health and safety investigation compliance were 100%, with a nutrition labeling compliance rate of 98.1% and nutrition labeling compliance claim percentage of 81.8%.

## Simple Food Inspection and Rapid Test Method

FIRDI aided the Agency of Food and Drug Administration in developing a method for quick, simple, and accurate food inspection. In just this year, we performed and compiled 50 items related to international bulletin food simple and quick way data. The Agency of Food and Drug Administration selected three items to be compared by three laboratories and selected 10 simple test kits for feasibility assessment.

## Analysis of Baby Formula and Follow-up Baby Complementary Foods

FIRDI aided the Agency of Food and Drug Administration in assessing minerals (sodium, potassium, calcium, magnesium, iron, zinc, phosphorus, copper, manganese) and trace elements (chromium, molybdenum, selenium) found in baby formula and follow-up baby foods. FIRDI gathered the latest domestic and overseas announcements and test methods and data and proposed appropriate analytical methods to ensure safety, including the analysis of standard reference materials, recovery test and repeatability analysis, to confirm the feasibility of

planned analysis. Furthermore, we monitored commercially available products to confirm method suitability and product labeling compliance. We completed various proposals for analytical methods and compiled analysis as a reference for the government's announcement of recommended baby formula milk powder.

## Taiwan Food Nutrition Database

The "Taiwan Food Nutrition Database" not only helps the researches on people's eating habits and healthy associations, but also provides accurate food nutrition information to consumers as the foundation for a food nutrition labeling system. Through the course of this year, we continued to increase the food composition analysis data of 33 foods; analysis items consisted of general components, minerals, vitamins, amino acids hydrolysis composition, fatty acid composition, cholesterol, dietary fiber, sugar analysis, etc. Furthermore, in accordance with national nutrition and food hygiene management policy requirements, we also helped the establishment of an edible oil database this year.

## Multi-target Real Time PCR Technology

Polymerase chain reaction (PCR, specifically real-time multiplex PCR) was used to quantify the genes of four food ingredients. Primers and probes for components of pigs, chicken and fish were designed according to the literature information. Using meatballs as the carrier, the test results showed that the linear coefficient  $R^2$  of this technology reached 0.97 and that the raw materials did not affect each other. The detection sensitivity is 1% and the sample error range is 1.2-3.3%.





Food nutrition component database in Taiwan



Fresh cut-off operations

### Residual Risk and Verification Indicators for Chlorine-based Byproducts

Based on the site conditions of chlorine-based disinfectants, the optimum conditions for lettuce salad sampling and preservation, the residual conditions of disinfection or the byproducts in various process stages, and the relevance of the use of disinfection agents, rinsing processes and residual amounts were investigated. The results revealed that semi-finished lettuce and finished market shelf products are not suitable sampling subjects for CAS product verification. The chlorine dioxide disinfection specimen located in the disinfection tank was found to be a better sampling subject. We recommend that auditors use sodium hypochlorite disinfectant for direct field sampling.

### Application and Safety Validation of Functional Packaging Materials

Novel antimicrobial and oxygen scavenging packaging were developed and incorporating into food system to make sure the effectiveness and safety. Using antimicrobial materials in packaged food can inhibit the growth of microorganism and extend the shelf life of food to reduce the defect rate of

products in cold chains. Meanwhile, pulse light activated oxygen scavenging function of caps was developed in this study. Pulse light systems developed by FIRDI can inactivate microbes rapidly and activate the oxygen scavenging function of the caps at the same time to prevent the microbial contamination and degradation of nutrition in beverage. For example, the oxygen concentration in the headspace of bottled juice with oxygen scavenging caps can be reduced to below 1% in five days.

### Industrial Personnel Training

Using the researches developed by FIRDI over the years and considering the need of the industry, FIRDI has held training programs on food processing, R&D, testing, quality assurance, functional assessment, biology and other relevant topics. The talent training resources of the government for food and biological industries was applied to plan the curriculum. Through communication between the industries and relying on the power of industries, government, academia and institutes, FIRDI systematically planned the practical operation curriculum and combined professional knowledge and skills. By doing so, we can improve the job profession of food safety



Real-time multiplex PCR



High-throughput high-speed tissue homogenizer

# Industrial Services



Microbiological testing class



Detection of GM foods

control, hygiene management, quality assurance, product R&D, production and processing technology, testing technology, and sensory evaluation.

This year we held 118 classes and trained 3,350 trainees. According to individual training needs, we further offered customized training and on-site trainings projects. We also coordinated with the Food and Drug Administration, Ministry of Health and Welfare to train health inspectors in the local health bureau. In response to the revision of the Act Governing Food Safety and Sanitation announced this year, FIRDI cooperated with the local government to establish both vertical and horizontal food safety net links and held the professional in-service training for food hygiene management personnel,

including "Food Hygiene Management Regulations Learning", "Study on Inspection of Commercially Available Food of Inspection and Registration", "Food Labeling, Nutrition Labeling Inspector Workshop", "Good Food Hygiene Practice Advanced Class" and other professional courses, to enhance the abilities of inspection personnel and food practitioners to improve independent management. The rate of student satisfaction was higher than 88% in average.

## GM Foods and New Generation Biotechnology Foods

In order to manage new generation biotechnology foods, Ministry of Health and Welfare entrusted Food Industry Research and Development Institute to draft "Management principle of biotechnology foods derived from zinc finger nuclease technique" in 2014. After two expert consult meetings and one paper review process, the management principle that defines the zinc finger nuclease technique with guidance on safety assessment was drawn up. The project also analyzed and compared the key components of the imported GM and non-GM soybean to provide an objective assessment on the safety of GM soybean and post-market monitoring.

There were 216 contract test cases in total for detection of GM foods in 2014, a substantial growth of 4 times higher than that in 2013. The main reason for the growth was the market for non GM products were expanded with companies devoting self-control on product quality. Another key factor was the regulation that organic soybeans need to prove the products contain no GM soybeans starting from 2013.



## Food Industry Analysis and Knowledge Service

### Dynamic Analysis of Food Industry Development

Under the support of the Ministry of Economic Affairs, the Ministry of Health and Welfare, and the Council of Agriculture, we have completed several survey and dynamic analysis of the development of food industry. We have communicated and shared the results with communities and provided related service in a variety of ways. The main achievement included the following.

Publication of "Food Market Information" monthly, which included 1,176 papers/abstracts and 1,038 figures or tables related to food policy and regulation, new product and new technique, food consumption, and trend of market development, which may affect the sales of our food products. Hopefully, the provision of the information may help the government and the industries in planning for development and in research strategies for research and development.

Publication of "Almanac of Food Industry, 2014", which covers information of foreign food industry and major food industries in Taiwan, including non-alcoholic beverage, frozen food, instant noodle, edible oil, health food, fresh deli food, animal feed, seasonings, food package and machinery, foodservices, and food distribution, with information of status quo of market development, trend for development, change of policy, and business dynamics.

Publication of "Almanac of Food Consumption Survey, 2014", which included basic data of consumers surveyed, consumer choice of food channel, personal eating habit and demand, and consumer behaviors for various foods. The almanac provides information including consumption characteristics and consumer behavior for various agricultural products and processed foods.

More information services and sharing, which included various industry surveys and research information disseminated through book publication, web presentation, E-mailing, workshops, share meetings, and seminars to disseminate information and getting feed back. In addition to the activities of the food information knowledge club, we also developed knowledge club in specific field, including non-alcoholic beverage, to provide members with first hand information and business

dynamics. In addition, we maintained food material information platform to provide global information of production and price of wheat, corn, soybean, flour, sugar and other materials for foods, price indexes of classified food commodities, and price information for food materials in future decade for food enterprises to grasp the trend of global food materials.

### Survey and Researches on Food Industry

We have accomplished several publications, including Report on status quo and future development of prepared food industry in Taiwan, Strategies and action plans for creating food safety monitor system, Development blueprint and strategies of new technology for food industry in Taiwan, Strategies and niche products in South Eastern food market for Taiwan, Strategies and opportunities for exploring snack food market in Indonesia and Cambodia, Status qua and opportunities of fresh deli food in Taiwan, Demand for elderly meal and opportunities for market development in Taiwan, Survey on tea industry in Taiwan, Analysis of dairy industry in Taiwan, Food policy implication via preference for agricultural products among different groups in Taiwan, A booklet of food industry in Taiwan, and Report on life style and consumption of health foods in Taiwan 2014. Meanwhile, we disseminated the information through industrial fast new report and industrial analyzing report to provide industry information with insight instantly, hopefully to help firms recognize clearly the food market, laws and regulations in Taiwan and China.

### Knowledge Service for Food Industries

We have accomplished several customized market researches for food industries, including drink market related reports, and provided information for Taiwan Association for Food Science and Technology to held annual meeting seminar on innovation in food industry. We also provided evaluation of food adulteration and safety issues on food industry, health food and alive seafood related management system, and law and regulation between Taiwan and Mainland China to government and related authority for policy making. The information service may also help enterprises in collecting information and getting new and whole industry information, thus immediately making clear the global and domestic market change and development trend to effectively grab the market pulse to do research and development and planning for marketing strategy.



# Special Report



Group photo



Speech from Mr. Tien-Tzu Wu, Chairman of the Board of FIRDI

## Cross-strait Cooperation and Exchange

### The Sixth Cross-strait Food Industry Cooperation and Exchange Conference

To promote cross-strait industrial interaction and collaboration, FIRDI has collaborated with Chinese Institute of Food Science and Technology (CIFST) to build a collaboration and interaction platform for food industries in mainland China and Taiwan. In December 2009, the First Cross-strait Food Industry Cooperation and Exchange Conference was held in Taipei, and thereafter, the conference is held every year (five conferences in total), and various issues on food certification, circulation, safety, functional food, and industrialization of traditional food had been discussed. The goal is to assist enterprises to improve cross-strait operation efficiency and to work collaboratively in developing global business opportunities. In 2014, the Sixth Cross-strait Food Industry Cooperation and Exchange Conference was held on July 29 at Xiamen International Conference Center. 150 experts from industries, government agencies, and the academic domain participated in the convention.

This time, an 18-people delegation, led by the chairman of the Board of FIRDI, Mr. Tien-Tzu Wu, represented Taiwan in the convention. Aiming for creating more collaborative business opportunities, the two parties, based on the spirit of achieving a close cross-strait interaction, carried out an in-depth discussion on development of the food industry, food safety, traditional food, talents and corporate innovation.

At the end of the convention, the two parties co-signed the consensus reached in the convention: The two parties

shall work cooperatively in the food industry and create a win-win situation based on equal priority between the two parties and the collaboration and interaction foundation established over the years. Both parties also agreed to hold the seventh conference in Taiwan next year.

### Promoting Cross-strait Food Safety Exchange

FIRDI implemented the TFDA commission plan of the Ministry of Health and Welfare in order to promote cross-strait food safety exchange. The main results were as follows: (1) planning and organizing the promotion team: invited Taiwan's representative experts to plan and organize the promotion team for food safety cooperation and exchange between Taiwan and mainland China to discuss issues, provide suggestions, and establish good communication channels with mainland China; (2) Handling exchange meetings: arranged a total of eight exchange meetings with food safety experts of both Taiwan and mainland China focused on principal issues such as food labeling, imported food management, and food safety regulation; (3) Holding seminars: hosted five cross-strait seminars related to the food nutrition labeling management, imported food safety risk monitoring, and food safety regulations so that management systems, regulations and supervision measures could be discussed; a total of 930 people attended; (4) Collecting and analyzing information: collected and analyzed the cross-strait Food Safety Management Laws and further collected real-time information about mainland China's food safety policies, standards, and regulations as a reference for cross-strait exchange.



## Dechnology

FIRDI cooperated with the scientific technology import design policies of the MOEA Department of Industrial Technology to increase the value of R&D achievements through the technology and design interactive platform. As a result, several achievements have obtained international design awards. For example, the Household Multipurpose Ohmic Heating Steamer and Cooker won both Germany's 2014 iF Product Design Award and the U.S.'s IDEA Product Design Award and the Compact Oil Bottle Stopper won Germany's 2014 Red Dot Product Design Award, thus obtaining international recognition of technology development programs of the MOEA.



The Compact Oil Bottle Stopper won Germany's 2014 Red Dot Product Design Award



The Household Multipurpose Ohmic Heating Steamer and Cooker won both Germany's 2014 iF Product Design Award and the U.S.'s IDEA Product Design Award

The 2014 R&D achievements, such as the microwave assisted with deep-frying technology and edible packing material, were also reviewed for value-adding opportunities of scientific R&D achievement and design cooperation. The achievements are introduced below.

### Microwave Assisted with Deep-frying Technology (Crisp Box)

Using the microwave deep-frying technology with high temperature, short time and energy efficient, Crisp Box can provide a deep-fried texture, succulence and juicy characteristics. With the popular demand on "seat economy (small comfortable space)", the Box can be designed and applied in convenience store for re-heating purpose.



Microwave Assisted with Deep-frying Technology (Crisp Box)

### Edible Packing Material (Creative Latte-Art Instant Drink)

Using FIRDI's edible film coating technology and focusing on the instant drink market, creative latte-art instant drinking, a new type of instant drinking, was designed. The principal design concept is an edible film with a decorative pattern in the instant drinking package. When making a cup of coffee, the edible film should be placed on top of the cup to make instant drinking more delicate. In addition to enjoying the drink, this product could also have commodity value. In the future, the pattern could be customized to provide consumers with different choices.



Edible packing material (concept of creative latte-art instant drinks)



Usage model of a creative latte-art instant drink

# Special Report



## BPCS Training Courses

In 2013, the representatives of the U.S. FDA visited factories and recommended that cannery workers receive Better Process Control School (BPCS) training and obtain certification and that BPCS be set up in factories. To help Taiwan's canning industry comply with Food Safety Modernization Act, (FSMA) requirements and expand the country's export business to the U.S., FIRDI won FDA recognition in the beginning of this year and can now hold BPCS training courses in Taiwan, thanks to joint efforts from a number of organizations.

Therefore, FIRDI invited the U.S. FDA recognized expert Dr. Y. Martin Lo to teach and manage the BPCS training course in Taiwan; 94 students from 46 manufacturers participated in the training and were granted the U.S. FDA recognized certificate. The contents of the training included low-acid and acidified canned food definitions, microbe principles, thermal processing sterilization, equipment, management and operations related to sterilization, container seals, etc. Furthermore, during the course, we connected with Dan Geffin, a U.S. FDA official, via the Internet. Not only were the U.S. status and related requirements for export to the U.S. explained, but we also discussed the issues of can exports to the U.S. Because of the courses' proper preparation and rich content, the trainees highly praised the courses, which will be helpful to work practicality, development and help.

## Consolidation of Can Industrial Service Business and Renovation of Pilot Plants

The departments of FIRDI have been reengineered in August, 2014. We consolidated the traditional can industry business and aseptic processing and packaging business



1

2

3

1. Sealing lab course

2. On-line discussion with U.S. FDA Official Dan Geffin

3. Sterilization operations and management

into "canned food business development unit" in Southern Taiwan Service Center. The reengineering movement aimed to combine services part and investigation part, by which we can provide more complete and better service to canneries and beverage manufacturers.

Beside routine assessments of homogeneity of heat distribution in autoclave chambers, heat penetration and sterilization value, we are planning to intensify safety and sanitary verifying to several processing systems, including new type manufacturing equipment, the UHT sterilizer and the sterilization system of aseptic filling. Furthermore, to improve the sterilization techniques of canned food and products development, we have renovated the pilot plants of can processing and purchased 2 more autoclave systems. We plan to purchase another filling system and can seamer to further construct a complete small-scale production line. By all above mentioned points, we hope that we will provide more diverse can processing and investigation services in future.





Q Exactive™ Hybrid Quadrupole-Orbitrap Mass Spectrometer, Thermo Fisher

## Monitoring Technology to Identify Emerging Food Safety Issues at Early Stages

As the last defense line in food safety evaluation, food inspection and analysis usually targets on specified pesticides, veterinary drugs, food additives, etc. Nowadays, the international trend is towards non-targeted analysis to combat food frauds and monitor environmental pollution and derivatives during food manufacturing process. High-resolution mass spectrometry (HRMS) is one of the powerful tools for non-targeted analysis. FIRDI has used the HRMS (with a Q Exactive™ Hybrid Quadrupole-Orbitrap Mass Spectrometer, Thermo Fisher) to build up the whole scheme of non-targeted profiling analysis on small molecular compositions of food ingredients and products. We hope to set up a precautionary platform with this technique that can tackle all possible hazards in the food supply chain from farm to fork and assist food manufacturers establishing a self-management system for food safety.

## The Edible Oil Event

After the inferior lard doping incident, FIRDI quickly addressed worries related to oil processing and aided the Ministry of Health and Welfare, Ministry of Economic Affairs

and other relevant government departments. We provided professional and technical consulting and support for the edible oil industry. Furthermore, FIRDI invested in analyzing inferior oil samples to facilitate the monitoring of edible oil quality and safety.

In cooperation with the Industrial Development Bureau, we aided in the following: factory audit (assisting the industry bureau to audit 11 factories using inferior oil and assisting the industrial bureau office to audit 223 factories with temporary registration), opinion polls (the GMP system abolished public opinion surveys, oil incident media reaction tracking), industry analysis (the structure of the edible oils and fats industry and lard industry supply chain analysis, analysis of daily updated oil events on industry output value, feasibility analysis of international waste oil processing and regulation case analysis, and the analysis of possible impacts or amendments caused by the oil incident).

For 23 categories and 894 products seeking GMP certification, FIRDI verified that they complied with both health and safety requirements. After the incident, the food GMP system became more sophisticated. In addition to health and safety requirements, we also improved source management and traceability requirements, while moving towards full product certification.

# Special Report

## 2014 Awards



Dr. Lu-Hung Chen, Deputy Director General of FIRDI (right), won the "Professor Stephen S. Chang's Outstanding Achievement in Food Science and Technology Award" from the Taiwan Association for Food Science and Technology, which was publicly given to him at the annual meeting of the Taiwan Association for Food Science and Technology on December 5 in Kaohsiung.



Dr. Lu-Hung Chen, Deputy Director General of FIRDI (left), won the "Mr. Hsieh Cheng-Yuan Special Contribution Award" from Mr. Hsieh Cheng-Yuan Food Technology Development Foundation on December 29 in FIRDI, which was presented by Mr. Meng-Chang Hsieh, Executive Director of FIRDI (right), on behalf of Mr. Hsieh Cheng-Yuan Food Technology Development Foundation.



FIRDI assisted the Taiwan Association for Food Science and Technology to hold the Food Risk Communication Forum. Dr. Wei-Guang Fu (right), Director of Analysis Service and Extension Center of FIRDI, represented FIRDI in receiving public praise at the annual meeting of the Taiwan Association for Food Science and Technology on December 5 in Kaohsiung.



Dr. Chung-Yih Wang, Researcher (right), won the "Mrs. Lien-Chen Chiang Hsu's Food Science and Technology Research Award" from the Taiwan Association for Food Science and Technology and received public praise at the annual meeting of the Taiwan Association for Food Science and Technology on December 5 in Kaohsiung.



The R&D team of the uric acid decreasing product won the "Mr. Hsieh Cheng-Yuan Innovation Award" on December 29 in FIRDI, which was presented by Mr. Meng-Chang Hsieh, Executive Director of FIRDI (right), on behalf of Mr. Hsieh Cheng-Yuan Food Technology Development Foundation.



Mr. Ju-Xian Liao, Administrator (2nd from right), Ms. Xiao-Dong Yang, Technologist (2nd from left), and Ms. Qian-Yue Zhang, Associate Research Scientist (1st from left), won the "Extension and Service Achievement Award" from the Taiwan Association for Food Science and Technology and were all publically praised at the Taiwan Association for Food Science and Technology's annual meeting on December 5 in Kaohsiung.





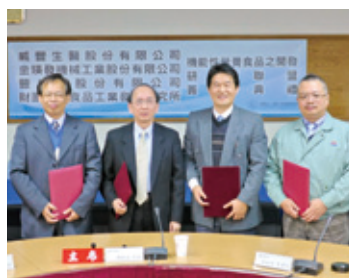
# Major Events



1/9



1/17



1/21



2/20

## January

**1/9**

Mr. Roumen Iontchev, a Member of the Bulgarian Parliament, led a team of four to visit FIRDl.

**1/17**

Consultant Dr. Chien-Hsun Lai, Technical Specialist of the Department of Industrial Technology, MOEA, visited FIRDl.

**1/21**

The R&D alliance signing ceremony of functional nutritious foods was held in Hsinchu. Dr. Shu-Kong Chen, Director General of FIRDl, presided together with Mr. Yu-Ming Fang, General Manager of Weifeng Biotech Co., Ltd.; Mr. Yu-Long Shi, Vice General Manager of Chin Ying Fa Mechanical Ind. Co., Ltd.; Mr. Zheng-Gang Liu, Chairman of Feng Shi Ji Co., Ltd. at the ceremony.

## February

**2/20**

Mr. Kuan Deng, the Deputy Secretary General of Party Headquarters of Ningxia Hui Autonomous Region of the Mainland, led a team to visit FIRDl.

## March

**3/5**

The technology transfer signing ceremony of FIRDl and Royal Chef Co., Ltd. was held, in which Ms. Yi-Lin Hsieh, Vice President of Royal Chef Co., Ltd., and Dr. Shu-Kong Chen, Director General of FIRDl, signed the contract.

**3/20**

The Announcement meeting of FIRDl's research achievements of 2014 and initiation of cooperation projects among industries and FIRDl was held in Hsinchu.

**3/25**

The Announcement meeting of FIRDl's research achievements of 2014 and initiation of cooperation projects among industries and FIRDl was held in Chiayi.

**3/25**

Mr. Robert Bell, founder of Global Smart City Forum, accompanied by De-Lin Du, Section Chief of Hsinchu Municipal Government's Department of Economics Development, visited FIRDl.



3/5



3/20



3/25



3/25

# Major Events



4/22



5/16



5/21

## April

**4/22**

The technology transfer signing ceremony of FIRD and Glac Biotech Co., Ltd. was held, in which Ms. Pei-Shan Hsieh, Section Chief of Glac Biotech Co., Ltd., and Dr. Shu-Kong Chen, Director General of FIRD jointly presided.

## May

**5/16**

Dr. Peng Gao, Secretary General of the Health Care Service Committee of the China Health Care Association, visited FIRD.

**5/21**

Mr. Zvonimir Mršić (CEO) and Ms. Olivija Jakupc (Executive Director) of the state-run Podravka Food Processing Company of Croatia visited FIRD.

**5/22**

Dr. Shung-Chang Jong, Consultant of American Type Culture Collection (ATCC), aided FIRD in guiding the research work and operational strategy of the Bioresource Collection and Research Center from May 22 to May 23.

## June

**6/24**

Dr. Sue Ellspermann, Lieutenant Governor of Indiana, USA, led a team to visit FIRD.

**6/26**

Mr. Andrew Cherng, Chairman of America Panda Restaurant Group, visited FIRD.

## July

**7/24**

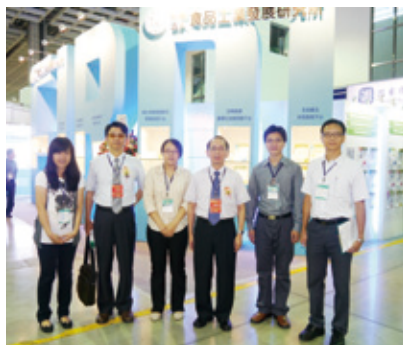
FIRD joined the Taiwan International Biotech Exhibition 2014 in Taipei.

**7/29**

FIRD and the Chinese Institute of Food Science and Technology collaborated to hold the "6th Cross-strait Food Industry Cooperation and Exchange Conference" in Xiamen, Fujian.



6/24



7/24



7/29





8/18



8/25



8/27

## August

**8/18**

FIRD I held the signing ceremony for the commissioned research of FIRD I and Taiwan Direct Biotechnology Corp.; Mr. Bing-Sheng Li, Chairman of Direct Biotechnology Corp., presided together with Dr. Shu-Kong Chen, Director General of FIRD I.

**8/25**

A farewell tea party for Dr. Shu-Kong Chen, Director General of FIRD I, was held.

**8/27**

The Handover Ceremony was held for the former and new Director General; presided over by Mr. Tien-Tzu Wu, Chairman of the Board of FIRD I. Dr. Chii-Cherng Liao assumed the position of Director General of FIRD I; more than 50 guests from industry, government, and academia joined the ceremony.

## September

**9/5**

Mr. Osamu Morishita of Japan's Chemtex Company led a team to visit FIRD I.

**9/30**

The "Cross-strait Food Safety Regulations Seminar" was held in Taipei.

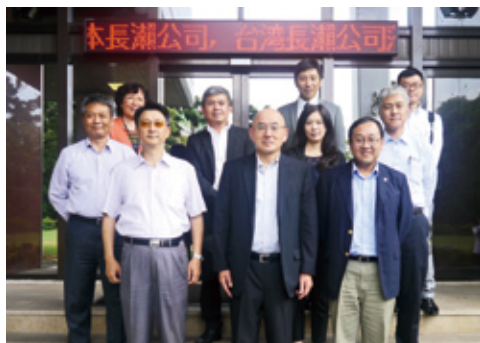
## October

**10/15**

The "Industrial Upgrading and Transformation Startup Service Team" of MOEA was established in Taipei. FIRD I was a leader among the Industrial Upgrading and Transformation Service Team – Offshore Service Branch.

**10/19**

FIRD I achieved the "Construction Plan of a Processed Livestock Product Traceability System", thus participating in Hsinchu Meatball Festival.



9/5



9/30

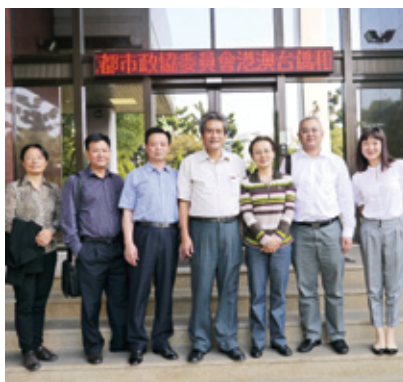


10/15

# Major Events



11/1



11/3



11/10

## 10/23

The "Food Safety Early Monitoring Technology Application Seminar" was held in Hsinchu.

## November

### 11/1

The FIRD's 47th Anniversary Celebration was held.

### 11/3

Ms. Ling-Li Tang, Director of Hong Kong, Macau and Taiwan People and Foreign Affairs Committee of CPPCC Committees of Chengdu, Sichuan, and Ms. San Wang, Ombudsman of Chengdu Food and Drug Administration, visited FIRDI.

### 11/10

FIRDI obtained U.S. FDA Certification and offered the "Better Process Control School" in Hsinchu from November 10 to November 14.

## 11/10

The signing ceremony of technical service of FIRD and Ecolab Co., Ltd. was held in Hsinchu, in which Mr. Tie Wang, Chairman of Ecolab Company, presided together with Dr. Chii-Cherng Liao, Director General of FIRD.

## 11/25

Prof. Yen-Con Hung of the Department of Food Science of the University of Georgia visited FIRD.

## December

### 12/9

Mr. Jin-Yang Liang, Vice Chairman of the Science and Technology Association of Fujian of mainland China, led a team to visit FIRD.

### 12/25

The "Industrial Upgrading and Transformation Service Team's Advocacy Explanation Session and Food Hygiene and Safety Regulation Training Program" was held in Kinmen. The "Industrial Upgrading and Transformation Service Team's Advocacy Explanation Session" was held in Matsuo.



11/10



11/25



12/9





2014 Annual Report

Food Industry Research & Development Institute

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Publisher/ Chii-Cherng Liao

Committee member/ Shiang-Tang Jane, Shu-Chen Huang, Shan-Shan Chen,

Yi-Hong Chen, Pei-Wen Lo, Su-Chen Lu

Executive editor/ Jui-Chuan Loe

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