FIRDI 2011

2011 Annual Report

Food Industry Research & Development Institute

Research. Development. Innovation
SINCE 1965

Food Industry Research & Development Institute
331 Shih-Pin Road, Hsinchu, 30062 Taiwan
Tel:886-3-5223191 Fax:886-3-5214016 http://www.firdi.org.tw

Southern Taiwan Service Center
5F,R3 Bldg., No.31 Gongye 2nd Rd., Annan District, Tainan, 70955 Taiwan
Tel:886-6-3847300 Fax:886-6-3847329

Chiayi Industry Innovation and Research Center, MOEA
No. 569, Sec.2, Bo-Ai Road, Chiayi, 60060 Taiwan
Tel:886-5-2918899 Fax:886-5-2861590 http://www.ciic.org.tw

FIRDI 2011
ANNUAL REPORT

RESEARCH

DEVELOPMENT

INNOVATION

2011

Food Industry Research & Development Institute
Annual Report

Contents

Preface

In 2011, due to the plasticizer incident, the output value for the year of 590.8 billion NT was close to 2010. This was approximately 4.09% of total manufacturing output (ranked 8th). There are approximately 6,000 companies in the industry. In recent years, due to the ageing of the baby boomers, the food industry has leaned towards providing quality and health products with an emphasis on specific consumer groups and developing food services such as catering and logistics. Also, with internationalization and resource exchange, food companies are utilizing their international advantages in resources and markets to actively spread around the world and increase their competitiveness.

FIRDI uses the core technology and various technological and service platforms to assist food and bio-industry in developing diverse and optimal products to satisfy industry development needs. In recent years, we have promoted a research and development strategy involving health concepts to increasing value added and developing food technologies that fit people's needs and has a specific health function with great results in the industry. Meanwhile, we developed novel, exquisite agricultural value added products using agricultural raw materials of Taiwan and helped to create new economic opportunities for the Taiwan fresh-cut produce industry. Also, we have used lean food processing technology and innovative catering service methods to integrate health foods into the chain restaurant system. This shows that FIRDI is actively participated in building Taiwan's quality food industry chain, and has expanded from providing services in food production to including agricultural processing and catering services.

FIRDI's Bioresource Collection and Research Center (BCRC) is the most comprehensive bioresources center in Asia in terms of its services and functions. We have established a long term collection and distribution platform, a systematic management system, and an ISO quality certification system for microbial, cell, and gene resources. Since 2010, we have provided a simple, effective, and safe 24 hour bioresources e-commerce service to our customers. After over a year of operations, this service has become the main channel for purchases. Also, we developed over 150 service items in 25 categories that are provided to over 1,000 R&D services. In 2011, we established an intellectual property management system, certified in February of 2011, which complies with the Taiwan Intellectual Property Management Standard (TIPS). In May of 2011, we participated in the Global Biological Resource Center Network (GBRCN) and its pilot projects. We also collaborated with the Centraalbureau voor Schimmelcultures (CBS)-KNAW Fungal Biodiversity Center in exploring innovative applications of fungal DNA codes in the biotechnology industry.

FIRDI established its office in Southern Taiwan Innovation and Research Park (STIRP) in 2005, where we actively promoted technological upgrade of food and bio-product equipments as well as integration of manufacturing processes. In order to help gear the food machinery industry to international standards in terms of health design capacity, FIRDI and the European Hygienic Engineering & Design Group (EHEDG) signed a contract establishing the EHEDG Taiwan Chapter in 2011 that will provide certification to food machinery companies in related equipments and expand the international market. FIRDI's team in the STIRP has long been promoting the food machinery industry and has been affirmed by being awarded the "Value-addition for Traditional Industries" by the Technology Development Programs of Ministry of Economic Affairs (MOEA) in 2011.

Chiayi Industry Innovation and Research Center CIIC, MOEA was opened in June of 2011. FIRDI has been assigned by the MOEA to operate the CIIC and provides comprehensive services to all industries. The CIIC is oriented toward health and healthcare, and we have established a pilot plant for companies to test trial products. This year, we have already assisted 11 companies from the Chiayi area to set up, and look forward to companies from all industries to utilize the CIIC's quality service capacity and resources.

Quality is the key to industrial development, and the May 2011 plasticizer incident greatly damaged the image of quality carefully crafted over the years in the Taiwan food industry. When this incident broke out, FIRDI immediately put together a plasticizer testing and analysis team that, through careful and accurate testing, quickly provided companies with certificates of safety and consultation services. Meanwhile, we have assisted government agencies in grasping and monitoring pollution in products on the market and quickly held the "2011 National Food Safety Conference" and the "President Ma and Food GMP Producer Forum for Increasing Food Safety" which effectively helped all sectors to come to a consensus and commit to action, allowing the incident to blow over within a short time period. FIRDI will continue to actively assist industries to establish risk management systems, polish Taiwan's quality food image, and create a safe food consumption environment.

In order to ensure and improve the credibility and expand the scope of FIRDI's services, most of our testing services are certified by the Taiwan Accreditation Foundation (TAF). In 2011, testing items that passed TAF certification included pesticide residue test, aflatoxin test, heavy metal test, and anti-microbial test (TN-019) in the nano silver antibacterial industrial plastic container. Projects that passed ISO international certification and are regularly reviewed include 5 health food function certification and safety evaluation projects split into two categories and 1 GMP operations project. In September of 2011, FIRDI established the Chiayi Regional Food Safety Inspection Service Center at the CIIC to provide Yunlin, Chiayi, and Tainan regional food companies a simple, fast food testing service platform that we invite all companies to utilize.

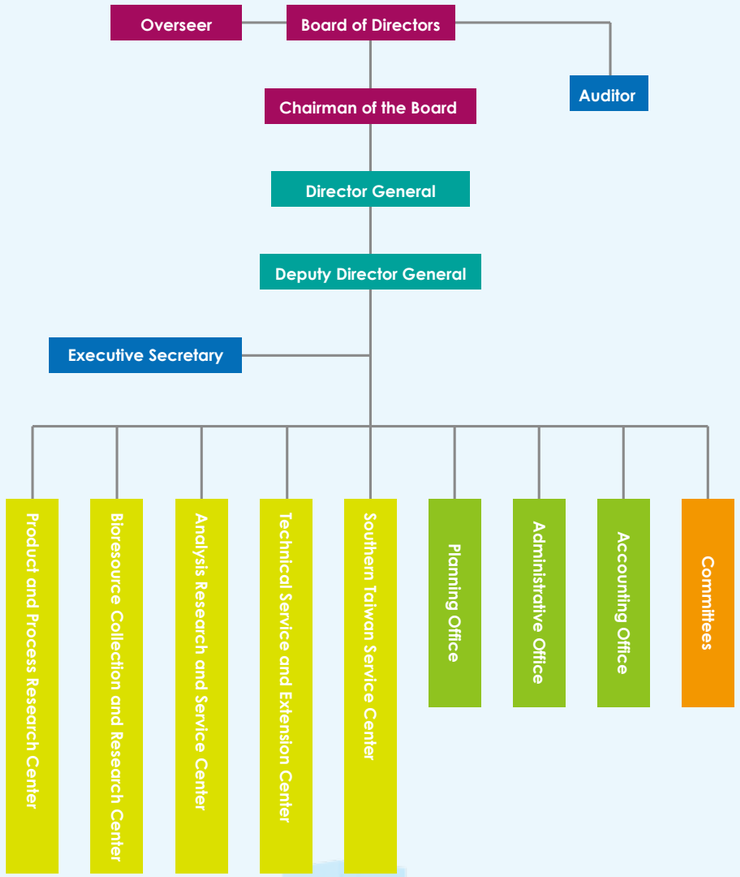
FIRDI has over 40 years of experience and has become one of the few research institutes around the world that has both food and bioresources capacity for R&D. Our goal is to become an internationally acclaimed food and bio-related industries research institute with a strong capacity for creating added value. We ask for continued encouragement and support.

Director General

Shu-Kong Chen

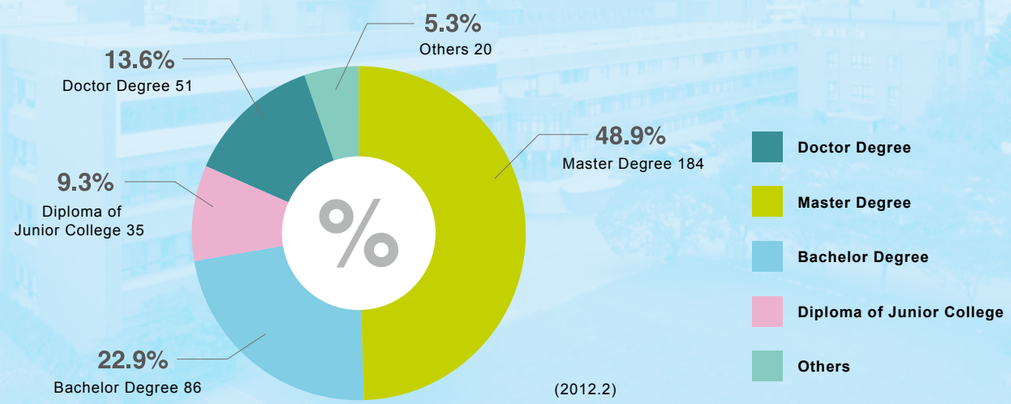
May, 2012

Organization



Human Resources

Number of employees: 376



(2012.2)

Technology Research & Development

01

/Technology Research and Development/

Value-addition for Food Products Using Health Concepts

I Functional Ingredients

1. Functional oils

The composition and position of fatty acids in triacylglycerols can dramatically affect their bioavailability and biofunction in human health. Polyunsaturated fatty acids such as DHA, EPA, or conjugated linoleic acid are known to be beneficial to human health. A selected species of marine microalgae with abundant lipids and polyunsaturated fatty acids was utilized as a raw material for oil extraction to obtain a high level of DHA constituents and to remove the undesirable saturated fatty acids and other free fatty acids. In our process, enzymatic esterification was used for lipid modification to reduce the undesirable constituents, and improve the oil quality and recovery during the oil refining process. In our study, original microalgal lipids containing 50% saturated fat were esterified with high oleic acid oil, giving a final oil product with only 25% saturated fats, and increasing the monounsaturated fatty acid content to 18%, while the DHA content remained the same as the level in the original sample. Moreover, the final oil product has a transparent appearance due to the reduction of saturated fats (Fig.1), which enhances the oil quality, health benefits and market value.

Fig. 1. The appearance of microalgal lipid without and with enzyme treatment.

2. Foodstuffs with anti-leukotriene function

Low dosage aspirin is often used to prevent myocardial infarction due to its ability to inhibit cyclooxygenase activity in the biosynthesis of thromboxane, which leads to a decrease in thrombus formation. But its ability to inhibit lipoxygenase activity in the biosynthesis of leukotrienes is low. In the current study, several compounds and extracts from vegetables and fruits showed better bio-function compared to aspirin. These natural materials include tea polyphenols, curcumin, and extracts of citrus fruits, sesame meal, roselle and green plum. Therefore, these foodstuffs have the potential to be developed as functional foods for cardiovascular protection (Fig.2).

3. Foodstuffs rich in antioxidants and dietary fiber

About 12,000 tons of deseeded-vegetable soybean hulls are produced annually by the vegetable soybean industry during the manufacture of frozen bean products in Taiwan. These by-products are usually used as feed or compost. This research aims to utilize the by-products to make deseeded vegetable soybean hull powder (Fig. 3) by crushing, milling, filtering, and drying processes. The powdered products are rich in nutrients, containing 28% protein, 54% dietary fiber, 826 mg/100g total phenols and 78 mg/100g isoflavones. The research also made use of deseeded vegetable soybean hull powder as an additive to make flakes. Results showed that utilization of the whole deseeded vegetable soybean hull is possible and that it can be used in the value-added food industry.

4. Products for lowering body weight and abdominal fat

A small molecule soy protein (SMSP) product was developed and incorporated in a low-calorie diet to help subjects feel full after a meal and to lower body fat after a period of dieting regimen. A variety of low calorie meals with SMSP were developed for healthy dieting. The SMSP can be easily added to staple foods, sauces, main courses, soups or desserts, according to consumers' choice, so the whole meal contains a designated amount of SMSP. This produces satiety, helping consumers to sustain dieting and reduce body fat. The meals were designed to meet several criteria, including functional flavoring, staple food functionality, and creating an operational platform. All these criteria were thought to be the most important requirements for success.

Fig. 2. Dry powders of kumquat fruit peel, roselle calyx, and lemon fruit peel (from left to right).

Fig.3. Deseeded vegetable soybean hull powder.

II Health Concept Products

1. Beverage products using mushroom polysaccharides

Polysaccharides are important ingredients in mushrooms and have anti-tumor, immunity enhancement and other physiological functions. Beverage products using mushroom polysaccharides have received attention recently. This study established a processing technology for the black fungus polysaccharide drink, including formula composition, processing conditions, and content analysis of polysaccharides and purines. Using this technology may reduce the processing period by half, compared with the current commercial process. Total polysaccharide content of the product may exceed 6.0 mg/mL, with good taste (Fig. 4).

Fig. 4. Beverage products using polysaccharides from black fungus.

2. Candied citrus products

The traditional candying process takes an extremely long time, which is the bottleneck stage in the manufacturing. This study developed candied orange slices (Fig. 5) by application of vacuum infusion technology. Pressure reduction can be used to facilitate the transmission of mass and enables materials to enter the product rapidly. The vacuum candying technology not only significantly reduces the processing period from 10 days to 4 hours but also improves product quality.

Fig. 5. Candied citrus products.

3. Specialty foods

The purpose of this project was to develop functional specialty products using domestic agricultural, seafood and animal materials. Eight items were developed (Fig. 6), including (1) Ma Po sauce: a unique formula was developed with emphasis on spicy taste; (2) Minced pork sauce: the sauce was made with a well-known soy sauce and various spices; (3) Mushroom sauce: fresh mushrooms were used as raw materials, giving a sweet flavor and fresh taste to the sauce; (4) Plum sauce: a traditional Taiwan plum sauce with a mix of sweetly, salty, sour, and fragrant flavor was made; (5) Sweet potato simmered with prebiotics: prebiotics and probiotics were added to high quality sweet potatoes in order to produce functionality and a special flavor; (6) Vegetarian yogurt product: functional vegetarian yogurt products were prepared with several fruits and live lactic acid bacteria by a special fermentation process; (7) Fermented bean curd sauce: adding fruit and pectin to the fermentation process improved the flavor and aroma of fermented bean curd sauce; (8) Fish sauce: fish and shellfish were used as raw materials, and a good taste was produced after natural fermentation.

4. Low-fat braised pork sauce

Braised pork sauce is representative of traditional Taiwanese cuisines, being rich in fat to enhance the flavor and mouthfeel. This research was to replace part of the fat with gelatin, a soluble protein compound obtained by heating and partial hydrolysis of collagen from pigskin. The industrial technologies for making braised pork sauces have been established, including pretreatment of pigskin, processing conditions and the mass production process. Furthermore, by increasing the content of pigskin, the viscosity of the braised pork sauce was significantly increased.

III Quality Control and Quality Inspection Techniques

We continued on the study of food quality control and food-processing technology. Food availability, shelf life and identification of food sources are progressively improved based on the application of these technologies.

1. Prevention of enzymatic browning of fresh cut vegetables and fruits by anti-browning agents

The most efficiency reagent combination for prevention of enzymatic browning was studied. Browning of Taiwanese fruits and vegetables including apples, pears, pineapples, wild rice stem, carrot, mushroom and shiitake after cutting are effectively suppressed. Fresh cut fruits and vegetables treated by specific reagent combination, followed by optimum package and chilled storage could have result in more than 3 times shelf life extension.

Fig. 6. Specialty functional agricultural, seafood and animal products.

2. Rapid simultaneous screen of pathogen in fresh food by biochip

The *fem*B, *mgt*B, *gyr*B, *gyr*B, *rfb*E/*fli*C and *plc*A genes were designed respectively as a primers and probes for detection of *Staphylococcus aureus*, *Salmonella* spp., *Bacillus cereus*, *Vibrio parahaemolyticus*, *Escherichia coli* O157:H7 and *Listeria monocytogenes*. About 10 and 1 CFU/ml of single and simultaneous of these six strains were inoculated into Taiwanese sea bream fillet. After 24hr enrichment the PCR products were specifically hybridized with its probe in biochip. The biochip was able to detect the pathogen correctly.

3. Simultaneous detection of food pathogen by real-time multiplex PCR

The virulence genes *stx*1, *fli*C, *eae* and *rfb*E for *Escherichia coli* O157:H7 and *hly*A, *inl*A, *plc*A and *dna*K for *Listeria monocytogenes* were designed as a multiplex PCR primers and probes for quantitative and simultaneous detection of these pathogens. There were no false positive results and with good specificity for all the designed primers and probes. The detection limits were 15 CFU/g and 25 CFU/g for mixed *Escherichia coli* O157:H7 and *Listeria monocytogenes* bacteria in food.

4. Inorganic elements as regional indicator of rice

Twelve inorganic-elements (Ba, Mo, Ni, Rb, Sr, Ca, Cu, Fe, Mg, Mn, Zn and Na) concentration of domestic and imported rice were analyzed for establishing source indicator. Koshihikari rice produced in Chishang village in Taitung County, Changhua County and Japanese can be clearly distinguished by Canonical Discriminant Analysis (CDA) of these 12 inorganic-elements. By CDA analysis of 8 inorganic elements (Mo, Ni, Rb, Ca, Cu, Fe, Mg and Zn) and their ratio to Zn (Ba/Zn, Mo/Zn, Ni/Zn, Rb/Zn, Sr/Zn, Ca/Zn, Fe/Zn and Mn /Zn), it can clear classification of the domestic and imported rice.

5. The service for event specific detection of GM soybeans

The service for event specific detection of six GM soybeans, including RRS (OECD UI: MON-04032-6), A2704-12 (OECD UI: ACS-GM005-3), A5547-127 (OECD UI: ACS-GM006-4), MON89788 (OECD UI: MON-89788-1), DP-356043-5 (OECD UI: DP-356043-5), and DP-305423-1 (OECD UI: DP-305423-1) was developed based on the demand of customers. This new service is of help for the export of domestic soybean products.

02

/Technology Research and Development/

The Innovation in Exploiting the Bioresources

I The Preservation and Distribution of the Bioresources

1. The collection of special bioresources

(1) The collection of plant endophytic fungi

Endophytes live in plants as a symptomless mycelium phase for all or nearly all their life cycle. Endophytes gain nutrients from plants with a beneficial to hosts in enhancing their resistance to pathogen, insect, and/or drought. Endophytes can also increase or induce the synthesis of secondary metabolites of hosts. Endophytes may have great potential in biological control, genetic engineering, and pharmaceutical. In this project, 60 endophytic actinomycetes and 100 endophytic fungal strains were isolated from 30 native plant species. All strains were well preserved at BCRC. Furthermore, small-scale fermentation and bioactive compound screening for selected strains have been carried out to exploit their potential on industrial application. Several strains with good bioactivity were identified and are worthy of further study.

(2) The collection and distribution of *Antrodia cinnamomea* strains

BCRC in FIRDI has collected 33 strains of *Antrodia cinnamomme*, 9 of which being opened to public. Numbers of *Antrodia cinnamomea* strains distributed are increasing annually (Fig.1). This sale trend indicates the health/functional claims of *Antrodia cinnamomea* have drawn the attention of small businesses. New research trends on differences between functional *Antrodia cinnamomea* strains, functional identification and characterizations, as well as related end products developments etc. are being conducted.

2. The establishment of fungal DNA barcode system

BCRC/FIRDI executed "The Establishment of DNA Barcoding System in Food Fungi" funded by the Council of Agricultural. This year, we have achieved the barcode of 125 fermentation strains within 55 species belonging to *Actinomucor*, *Mucor*, *Absidia*, *Fusarium*, and 254 food and medicinal mushroom strains within 87 species by sequencing their rDNA ITS1-5.8S-ITS2 and other identifiable gene. The barcode also combined with the morphological characters. Up to date, a total of 46 genera, 234 species, 861 strains have been sequenced in the BCRC barcode project within three years. All fungal barcode information from this project was used to build the database and construct the "Funcode" website with sequence analysis and comparison of function. Through this project, BCRC could provide more accuracy identification of fungal strains based on morphologic characters, sequence information, and photos. DNA barcode techniques and its database in BCRC will be beneficial to Taiwan bio-industry in improving quality control, product resume tracking, and rapid identification of the fungal strains for food mass-production.

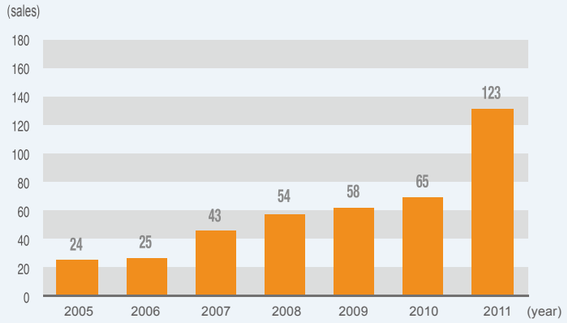


Fig. 1. Annual sales of *Antrodia cinnamomea* strains.

Fig. 2. Morphology and karyotype of iPS derived from trisomy 18 cells (Edwards syndrome).

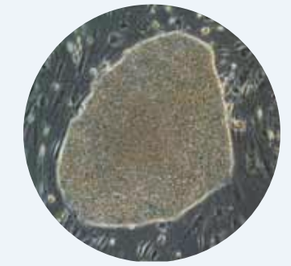


Fig. 3. Morphology and karyotype of iPS derived from trisomy 21 cells (Down syndrome).

3. The establishment of induced pluripotent stem cells (iPS)

BCRC has established two diseased AFMSC-derived iPS this year by lentiviral transduction of Yamanaka factors, including Edwards syndrome (trisomy 18) (Fig. 2) and Down syndrome (trisomy 21) (Fig. 3). The iPS cells have hESCs-like morphology and pluripotency. The karyotype of iPS is found to be the same as original AFMSC. These iPS cells are useful for specific disease research or drug screening. The Down syndrome iPS is used to study neuron development by BCRC.

II Bioresources Management and Services

1. Culture distribution and technical services

BCRC's focus on culture distribution and technical services in 2011 were: (1) high quality management of bioresources transfer platform, (2) quality assurance of bioresources repository, (3) value addition of bioresources with systematics technology, and (4) promotion of bioresources by integrating and marketing with thematic knowledge. In this year, a total of 873 microbial strains with expansion of additional 160 species belonging to 36 genera and 210,000 clones of genetic resources were newly collected. 4,870 batches of culture were distributed. 1,584 cases of contract test, identification, training, and/or deposit were completed. More than 300 strains were imported for customer needs. BCRC keeps high quality management of bioresources transfer platform. More than 25,500 strains of microbial resources, 19,100 cell lines, and 1,250,000 clones of gene resources are long term preserved in bioresources repository with high standard management. Over 5,000 batches of bioresources were renewed. 960 bioresources were value added with rDNA sequencing technology, systematics analysis and differentiation, and/or enzymatic activity screening.

2. Quality accreditation of bioresources management and services

BCRC keeps maintaining quality management system under ISO 9001 and ISO/IEC 17025:2005 (BCRC is a TAF-accredited test laboratory accordingly). To improve management and services, in this year, a test item of "TN-019 nano silver anti-bacterial industrial plastic containers-antibacterial test" was added to TAF-accredited scope. Taiwan Intellectual Property Management System (TIPS) was integrated to the intellectual property management of BCRC. Reference Material Producer (RMP) certification under ISO Guide34 was verified for production of bacteria, fungi, and cell line reference materials.

3. Biological material deposits for patent purposes

On April 21, 1994, FIRDI was entrusted by the MOEA as the designated national depository for biological materials related to patent application. "The Regulations and Rules of Biological Materials Deposits for Patent Purposes" was promulgated accordingly. To improve service satisfaction, the ISO 9001 quality management system has been adopted for this deposit service since 2000. As of December 2011, a total of 1,921 biological materials have been deposited for patent purpose, including a wide variety of biological materials (Table 1). Viability tests are carried out according to a standard operation practice upon receipt of biological materials. To ensure safety and confidentiality of the deposited biological materials, the depository database and storage rooms are operated under strict managerial regulations. In addition, the patent biological materials are offered for research purposes upon request after the patent is issued. Consultation is provided as necessary to time by FIRDI through various channels. During this year, 129 biological materials have been deposited for patent purpose. BCRC use e-flow system to maintain and improve the management and service of the patent biological materials. The cryopreservation technology of plant cells and the storage rooms for long-term preservation of seeds have been established.

Table 1. Types of deposited biological materials for patent purposes.

Type of biological material	Percentage
Bacteria	31
Yeasts	5
Filamentous fungi	7
Plasmids	35
Hosts	–
Cell lines	15
Viruses and phages	2
Others	5
Total	100

(till the end of 2011)

4. Bioresources Knowledge Base

Knowledge-based service is expected to glow in the future. Following this trend, BCRC not only has held the key technologies of bioresources conservation and development, but also developed knowledge-based service, such as providing technical guidance, publishing achievement in researches and bioresources news regularly, setting up BCRC online classroom for digital tutorial, and introducing the International Taxonomy Database for references. Digital archive technology has been used extensively by BCRC for the digitalization of bioresources. Furthermore, BCRC has set up cloud collaboration platforms (google or wikipedia) for the development of Bioresources Knowledge Base as well as better service quality on the knowledge-based service platform. The knowledge-based service and application have established in-depth fundamental researches and created new service business. After the establishment of the knowledge-based service platform, the total views of BCRC webpage has increased 1.5 times from users over 140 countries and over 4,170,000 visits in 2011 (Fig. 4).

Year	2008	2009	2010	2011
Number of Cases	3,835	4,203	4,827	4,687
Number of E-forms	17,034	18,125	20,245	20,724
Total visits of webpage	1,427,891	1,747,685	2,356,941	4,170,592
Number of Visiting Countries	117	139	151	143
Number of Active Customers	1,955	1,990	1,936	1,952

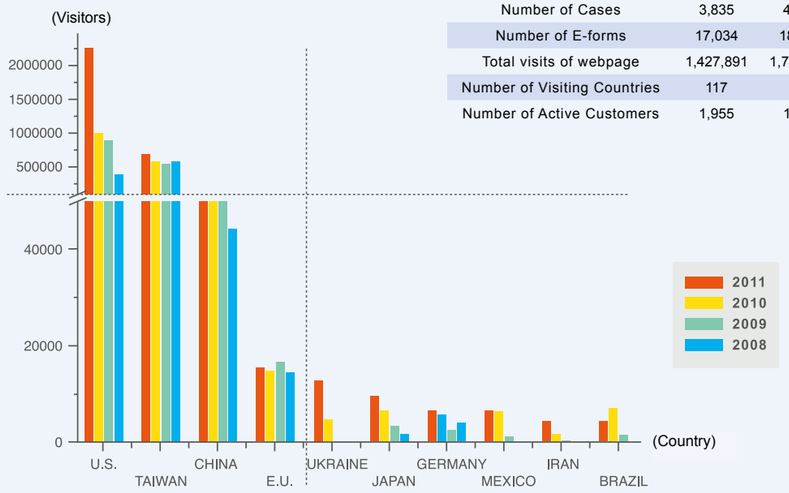


Fig. 4. Analysis of annual webpage usage.

Fig. 5. Dr. Shu-Kong Chen (right), Director General of FIRDI, and Prof. Dr. Pedro W. Crous (left), Director of CBS, signing the MOU between the two organizations.

5. International cooperation

(1) Fungal DNA barcoding cooperation project between Taiwan and Netherlands

Centraalbureau voor Schimmelcultures (CBS) Fungal Biodiversity Centre is the worldwide leader in collection, preservation, taxonomy, and database construction of fungi. Recently, CBS plays a major role in the fungal DNA barcoding. FIRDI has been supported by the Ministry of Economic Affair to execute the International Cooperation Program-"Fungal DAN Barcoding Cooperation Project between Taiwan and Netherlands". FIRDI and CBS signed a memorandum of understanding (Fig. 5). The MOU aims to establish the exchange platform for cultures and DNA barcode information. Both organizations will collaborate on sharing DNA barcoding research outcomes in the taxonomy study of mutually interested fungal groups. It would enhance the bioresources sharing and be value added for bioresources.

(2) BCRC joins Global Biological Resource Center Network (GBRCN) Demonstration Project

BCRC is the first GBRCN Cooperating Partner and has agreed with GBRCN Secretariat (represented by DSMZ) to contribute to the German Federal Ministry of Research and Education (BMBF) funded GBRCN demonstration project. BCRC contributes to the GBRCN work by delivering input and commenting on developed documentation and model practices, such as code of conduct on biosecurity. BCRC also provides the OECD Best Practice implementation self-assessment to the GBRCN work for completion of BRC assessment of impact on implementing best practice.

III Exploring Biological Resources for Industrial Application

1. Establishing the identification standards for *Antrodia cinnamomea*

Bioresource Collection and Research Center utilized molecular and cellular techniques to develop methods for distinguishing different *A. cinnamomea* strains. Pairs of primers for amplifying segments of distinct genes have been developed and the polymorphisms of the sequences from 76 strains were used in phylogenetic analysis. The established database can be used to analyze new or unknown *Antrodia* strains. To access the composite cytotoxic effects of the complex *Antrodia* extracts, cancer cell lines were also analyzed in real-time by an electric cell-substrate impedance sensing system (ECIS). Results from analyzing 12 strains showed extracts from fruiting bodies, liquid cultures, and solid cultures produced distinctive patterns in ECIS system. While the fruiting body samples evenly exhibited pronounced cytotoxic patterns in certain cancer cells, the cytotoxic effects of the fermentation samples varied. By combining molecular and cellular technologies, we offer a system that could promote the healthy growth of the *Antrodia cinnamomea* industry.

2. The construction of fermentation banks of marine microorganisms

The metabolites of marine microorganisms prove to be a promising source for drug development owing to their wide bioactivities, such as antibacterial, antitumor, antivirus, anti-inflammatory and enzyme inhibitory activities. Rich and diversified microorganisms can be found in marine environments of Taiwan. However, there are only few detailed studies on their application. In this project, marine microorganisms isolated from different regions in Taiwan were cultured by 2 submerged fermentation mediums to establish the fermentation banks for evaluation of multiple enzymes inhibitory activities and anti-tumor activity by MTT assay. Results revealed some strains with high cytotoxicity and enzymes inhibitory activities have potential for drug development.

3. Production of resveratrol by biotransformation with microorganisms

Resveratrol is produced as a phytoalexin which may have various physiological activities. It can be produced by extraction from plants, cell cultures and recombinant microorganisms. However, the technical barrier is still too high for economic production. The most effective process for producing resveratrol now is biotransformation from Japanese knotweed using a microorganism (Fig. 6). A potential yeast strain was selected with high resveratrol-converting activity from BCRC collection. The conversion rate from polydatin to resveratrol was more than 60% with Japanese knotweed as medium by a 20 L fermenter (Fig. 7). The establishment of resveratrol production process will not only supply the material but also expand its application in Taiwan.

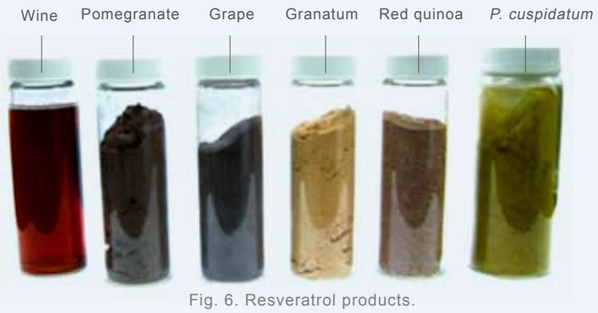


Fig. 6. Resveratrol products.

Fig. 7. The manufacture procedure for resveratrol.

03

/Technology Research and Development/

Product Innovation in Peripheral Industries

I Modification and Formulation Technology for Functional Material

1. Starch modification technology

A pectin modification process was developed and can be applied to produce resistant starches from most starch sources. The product is suitable for addition to foods with a high starch content to improve colonic physiology and to increase the value added to rice and wheat staple foods. The results showed that in *vitro* digestibility of pectin-modified starches was decreased by more than 20%. Resistant starches were introduced into steamed buns and noodles, and the glycemic index of each of these products was lower than that of white pan bread, by evaluation in healthy human subjects. This technology has received patents from the U.S.A. (US7727975), Japan (4694550), and R.O.C. (I340632) and has been transferred to the domestic starch factory to produce a product with the dual health benefits of water-soluble dietary fiber and resistant starch (Fig. 1).

Fig. 1. Resistant starch and related processed products.

2. Micronization for the physicochemical properties modification of cellulose

This project uses extrusion cooking and ultrafine grinding to enhance cellulose degradation and drying efficiency to produce modified bio-fiber from agricultural byproducts. The products show a higher soluble dietary fiber content and better solubility/taste and can be further used as stabilized materials for extraction of special functional compounds. This year, pressure adjustment fixtures and a feeding device for low-flow powders were developed and can be used to reduce by 20% the moisture content of extruded products. Combined with the ultrafine grinding process, this can reduce particle size to 100 μm (Fig. 2). Functional evaluation showed the modified bio-fiber showed increases of more than 15% and 10% in fat adsorption capacity and pancreatic lipase inhibitory activity, respectively. The ratio of soluble to total dietary fiber, solubility and antioxidant activity also showed increasing tendencies. Sensory evaluation and texture analysis showed that the powder aroma and mouth feel were improved by the extrusion and micronization treatment. Accompanied by formulation and processing adjustments, the modified bio-fiber can be added to meatball and patty products to increase their dietary fiber content by up to 3%.

Fig. 2. Modified bio-fiber products.

II The Prebiotic Health Food Service System

Using R&D techniques for shared semi-finished food products, we developed 4 sauces: a pectin paste from gelatinized lotus seed, mayonnaise, onion garlic paste and curry (Fig. 3). Then, using many prebiotics derived from vegetables and fruits with a high fructan content, we derived 11 semi-finished products containing functional oligosaccharides and dietary fibers exceeding 3 and 5 grams, respectively, per product (Fig. 4).

These techniques may help hospitality entrepreneurs build private central kitchen SOPs that will differentiate them from competitors, and/or help the food industry improve the connection between food industries and hospitality services to expand into new markets. The employment of web-based communications platforms renders the exploration of individualized healthy meal needs and builds a respondents screening platform. Such platforms allow customers to share their personal opinion of real products and offers scientific data with no limits of time and space, which permits real-time assays of real products via the internet. Food enterprises are able to improve products through statistical and analytic data. The integration of backstage database flows and a node tracking system gives sufficient understanding of the location and connection interfaces of customers and thus helps hospitality entrepreneurs improve product promotion and marketing in terms of market segmentation.

Fig. 3. Fruit and vegetable basic sauces (from left to right: pectin paste with gelatinized lotus seed, mayonnaise, onion garlic paste and curry).

Fig. 4. Semi-prepared products for catering (from left to right: pineapple burdock stuffing, sweet potato custard sauce, Thousand Island dressing, Salsa).

III System Integration and Counseling Services for the Food Machinery Industry

1. Development of an aseptic filling system for small volume glass bottles

The key components of a container sealing module for 50 and 100 ml glass bottles developed in this study were validated by microbiological verification technology. A sterilizable container sealing prototype device was designed, with a production capacity of 3,000 bottles per hour, showing the feasibility of an optimal container sealing module. Meanwhile, the reliability of the sealing system was assessed by the container sealing tightness test. To monitor the sterilizing control point of glass bottles, the glass containers were inoculated with *Bacillus subtilis* following sterilization with heated hydrogen peroxide. The results showed a 4 LCR sterilizing efficiency. To evaluate the sterilizing efficiency of the small-volume aseptic filling chamber, the chamber was sprayed with hydrogen peroxide, atomized by heating to 200ºC and a 5 LCR sterilizing efficiency was obtained. The same sterilizing efficiency was also achieved for the clamps of containers by increasing the capacity of the spray nozzles (Fig. 5).

2. Development of microwave assisted biotech processing equipment

An integrated system was designed and developed by combining microwave-assisted vacuum-concentration/drying with microwave-assisted extraction equipment. It offers adjustable microwave power levels and includes a stirring section. It is tolerant of both acidic and alkaline conditions and suitable for powder or concentrated liquid. Compared with the traditional processes, the overall microwave assisted concentration/drying time for heat sensitive or sticky products can be reduced by more than 20%. Meanwhile, the integrated processing technology of microwave-assisted extraction and vacuum concentration/drying was also applied to the extraction and concentration of functional, highly viscous and thermally instable ingredients, such as superoxide dismutase (SOD) and lentinan. Furthermore, analysis platforms for the functional ingredients were used to establish quality indicators and process control conditions as the basis for product development and commercialization (Fig. 6).

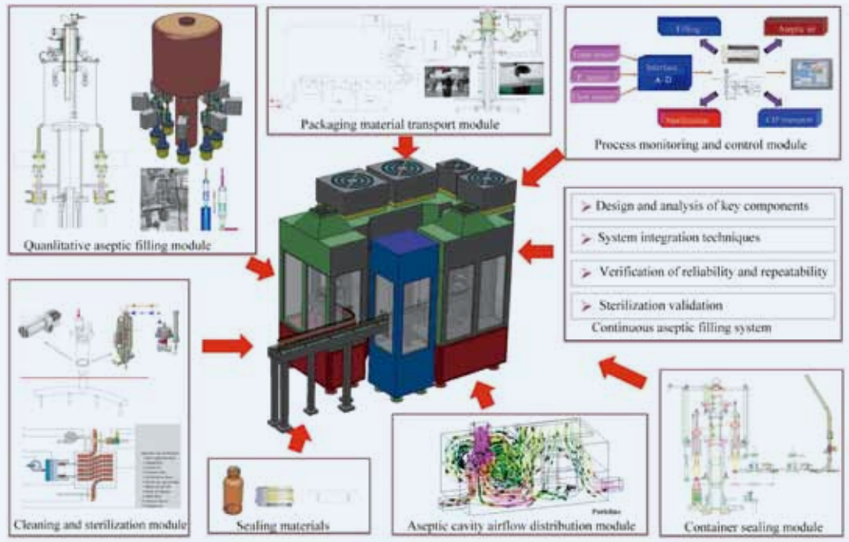


Fig. 5. Integrated system for aseptic filling of small volume glass bottles.

3. Commercializing process integration and pilot production of functional foods

The degradation kinetic models and residual liquid in functional ingredients during processing and storage were studied, and a quality estimation assessment of ingredients processed aseptically was also established. The results show that the decay of vitamin C in commercial fruit juice under different storage conditions follows zero-order kinetics, and the content of vitamin C at room temperature in sunlight for 15 months still meets the content specifications for the products. Furthermore, health and functional beverages with high nutritive value were tested to investigate the formulation, emulsion stability, protein stability and the residual content of the nutrient ingredients under continuous sterilization. The results show that process efficiency and quality retention by the fast dissolving tank is better than with the on-line powder dissolving system. The functional ingredients become unstable when kept at warm temperatures for a long time. More functional ingredients can be retained by ultra-high temperature instant sterilization.

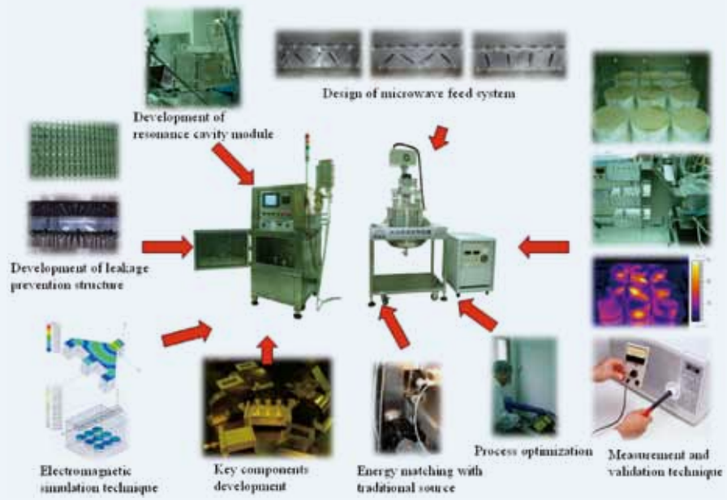


Fig. 6. Key modules for microwave assisted vacuum-concentration/drying and extraction systems.

04

/Technology Research and Development/

Upgrade of Local Industries through Innovative Research & Development

I Establishment of the Chiayi Industry Innovation and Research Center (CIIC) as the Benchmark for Innovative Development

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. CIIC was established on June 12, 2011, and construction was completed in Oct, 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, schools and research institutes in Southern Taiwan.

1. Integrating R&D resources of the four research institutes

We have integrated the R&D resources of FIRDI, the Metal Industries Research & Development Centre (MIRDC), the Precision Machinery Research & Development Center (PMC) and the Cycling & Health Industry R&D Center (CHC) within CIIC. In 2011, 40 researchers moved in and 100 more researchers will be added in 2012. In CIIC, FIRDI focuses on promoting production process and equipment development for agricultural and food resources. PMC plans to construct clustered-chain technology for the green energy industry. MIRDC will develop key production process equipment for health food ingredients while CHC will develop electric wheelchairs and other mobility aids with its research technology.

From a research technology position, CIIC plans to develop near-commercialized product technology, operate pilot plants and offer total solutions to satisfy the demands of local industries.

2. Combining research resources of local schools

On Dec. 20, 2011, CIIC held a Memorandum of Understanding (MOU) Signing Ceremony and signed the MOU for innovation and research cooperation between Schools and Research Institutes at 13 local universities in Chiayi/ Yunlin, including National Chiayi University, National Chung Cheng University, National Yunlin University of Science and Technology, National Formosa University, National Taiwan University of Physical Education and Sport (Chiayi Campus), Nanhua University, China Medical University (Beigang Division), Chang Gung University of Science and Technology (Chiayi Division), WuFeng University, TransWorld University, Tatung Institute Of Technology, TOKO Technology & Management College and Chung Jen College of Nursing, Health Science and Management. With this mutual consensus, we are hoping to combine the research know-how of both sides to promote and advance innovation and transformation of local industry.

Fig. 1. Dr. Ming-Chi Wu(left 3), Director General of Department of Industry Technology, MOEA and Dr. Shu-Kong Chen(right 1), Director General of FIRDI hosted the opening ceremony of Chiayi Regional Food Safety Inspection Service Center which was held in CIIC.

3. Assisting local business with innovative research & integrated services

CIIC has created opportunities to visit important enterprises within the Chiayi, Yunlin and Tainan area in order to understand what difficulties they encounter and provide helpful consultation during its pre-operation period in 2010. In 2011, we visited 179 firms a total of 322 times. To satisfy firms' demands, CIIC has matched appropriate research institutes with firms for consultation to offer total solutions. So far 11 firms have become business tenants in CIIC, including Yang Ming Biological Technology, Mei-Shan Tea-seeds Oil Manufactory Cooperation, Taiwan NJC Corporation, Dosun's Taiwan Coffee, Innovation Cloud technology, Huashih Corporation, Dry Ice Technology Corporation, I-Mei Biotechnology, Hondao Senior Citizen's Welfare Foundation, Powerful Eco Technology Corporation and Yeu Ming Tai Chemical Industrial Corporation.

There were also 19 conferences and training courses held, providing 600 attendees with professional knowledge. Furthermore, to meet local requirements, we established the Chiayi Regional Food Safety Inspection Service Center on Sept. 20, 2011 to provide a more convenient and faster inspection service for the local food industry. We have also encouraged the participating research institutes in CIIC to form four research groups and hold 10 forums on specific related subjects, expecting to stimulate innovative ideas and cooperation opportunities through interacting with each other within these knowledge-sharing platforms.

Fig. 2. MOU Signing Ceremony with 13 local universities in Chiayi & Yunlin on Dec. 20, 2011.

II Guidance of the Upgrade and Innovation of the Offshore Food Industries

1. Guiding innovative research of local industries in Kinmen

The Product and Process Research Center of FIRDI took part in the Academic Technology Development Program (Technical Development of Functional Products of Sorghum Distillery Residues) and Small Business Innovation Research (R&D Alliance of Innovative and Value-added Kinmen Speciality Products) to help revitalize the local economy by using local specialties to develop healthy new products. The annual project aims to inject new ideas into production of traditional products such as beef essence (Fig. 3), burdock and peanut candy. Kinmen beef essence showed higher antioxidant activity than chicken essence. Aged 'black' burdock increased numbers of the beneficial gut microbe *Bifidobacteria*, and stimulated gastrointestinal transit. Healthy peanut candy showed lower fat oxidation and increased functionality. After establishment of the related technologies, this will enable Kinmen agricultural products to be more diverse and convenient, enhancing competitiveness and market segmentation.

Fig. 3. Beef essence.

2. Promoting innovative research of local industries in Penghu

In order to solve the problems of production season limit, high cost of raw material storage and processing difficulties for developing cactus products and processes, the Southern Taiwan Service Center of FIRDI assisted the Red Fruit Biotech and Fusheng Food corporations to apply for Penghu's small business innovation research project (SBIR). In addition, three local traditional food

manufacturers also joined together to submit a SBIR to improve the food packaging materials and avoid contamination of local special products and traditional cuisines by the packaging. Through designing and selecting effective packaging materials for traditional foods, the convenience, beautiful appearance, safety and recognition of packaged foods are enhanced (Fig.4).

3. Launching of ''Matsu Industrial R&D Alliance'' to promote the development of local food industries

According to the policy of the Ministry of Economic Affairs, BCRC is responsible for organizing the ''Matsu Industrial R&D Alliance'' to help the industrial and commercial development in Matsu and balance the gap between homeland and offshore islands. In this year, the Mazu Industrial R&D Alliance was promoted with great success. Four novel products, including Matsu old wine vinegar (Fig. 5), red koji pineapple cake (Fig. 6), Hong-Zao sauce, and Hong-Zao pickle were developed and created more than one million NT dollars income. Moreover, we further promoted a SBIR project to develop the old wine vinasse cosmetic products to expand the Mazu old wine Industry value chain. It is noteworthy that Hong-Zao egg rolls, developed at 2010 by Matsu Alliance, has wined the Matsu characteristics Souvenir Award. The award demonstrated the quality of local specialties was widely accepted by consumers. In future, FIRDI will continuously devote more efforts into offshore islands to promote local industrial development.

III Establishment of Guidance Team for Upgrading the Food Industry

FIRDI established the "guidance team for upgrading the food industry" in compliance with government policies. This guidance team was primarily concerned with the farming counties in central and southern Taiwan, including Yunlin, Taichung, Changhua, Nantou, and Chiayi. In 2010, in response to trade liberalization, guidance was expanded to include the entire country, focusing mainly on promoting competitiveness of small and medium food companies that rely primarily on domestic sales and emerging biotechnology companies that are not as stable. From 2009 to 2011, the guidance team aided companies in applying for a total of 396 government subsidy plans and other projects.

The companies saw an improvement in their manufacturing processes as well as their research and development capacities for new products, as the guidance team helped with over 100 different such projects. This has helped the companies invest more than 1.95 billion NT and increase their production value by 3.98 billion NT.

Fig.4 MaZu Noodles.

Fig. 5. Matsu old wine vinegar.

Fig. 6. Red koji pineapple cake.

Industry Service

01

/Industry Service/

Food Safety and Quality Control

| Food Quality Control Certification and Accreditation

1. The promotion of CAS food system

A total of 11 categories of CAS product were promoted by FIRDI. In 2011, 154 food manufactures and 382 follow-up inspections were completed. Drug and pesticide residue of meat and fresh cut vegetable sample from 10 manufactures were evaluated and unsatisfied products were immediately informed and were organized until these producers were found compliant. Besides, 95 products supplied to school for lunch box meals were fortified to drug and pesticide residue analysis for safety confirm.

2. Food GMP accreditation system

FIRDI aided the Industrial Development Bureau, Ministry of Economic Affairs in promoting the food GMP accreditation system and continues to maintain its credibility. This year, after the plasticizer pollution incident, we immediately added additives as a category in the food GMP accreditation system while adjusting general and specific rules for traceability and management of raw materials and additives. We also promoted the accreditation of the related industries in the food production chain. For example, we have already established the specific rules for food packaging, and are evaluating cleaning disinfectants. We also provide advisory and diagnostic services to guide businesses into the quality control system and, through periodic checks, have enhanced self management capabilities. Currently, 389 factory lines and 3,147 products have been certified.

3. HACCP in boxed lunch plants and foodservice establishments

In 2011, 57 of boxed lunch plants and foodservice establishments were newly passed the HACCP based hygiene accreditation and certified to use HACCP logo approved by the Department of Health (DOH). These HACCP applications has significantly increased in hotel catering proportion, showing their attached importance to consumers' food safety and support to the international food safety system for enhancement their competitiveness.

4. Food safety management system for canned food

This year, our professionals and equipment helped the Department of Health provide 565 sterilization standards for canned foods on the market. Then, through follow ups at 82 factories, guidance for 10 companies with sales abroad, and 105 tests of products on the market, we tested the food safety and quality of canned foods on the market. Also, we held a Canned Foods Workshop for canning factories to understand the importance of food safety and to show the results of their work in the canned food industry.

5. Food safety management system for dairy products

After the Department of Health released a bulletin on the implementation of a food safety management system for the dairy industry, FIRDI took charge. This year, for 57 dairy companies, we aided local health departments in checking 40 production lines listed in first stage of the bulletin (fresh milk, UHT milk, and flavored milk) and guided 25 production lines listed in the second stage of the bulletin (yogurt, condensed milk, and milk powder) into the food safety management system. All events that did not pass the check and important regulated points were entered into a database. Meanwhile, we also provided training in checking, result symposiums, and company workshops.

6. Alcohol product certification system

Since 2003, FIRDI has aided the Ministry of Finance in promoting the alcohol product certification system meant to guide alcohol companies in the production of quality alcohol products and to ensure alcohol safety. In 2011, 4 companies obtained alcohol certification for products including Kaoliang, rice wine, cooking rice wine, grape wines, wines made from other fruits, and reprocessed alcoholic beverages. Currently, a total of 37 alcohol factories and 235 alcohol products have been certified.

7. Management of vacuum-packed foods and improving the quality of bean curd

The Department of Health put FIRDI in charge of guiding vacuum-packed food companies and help them apply for testing and certification for their vacuum packaging and soy products. This year, we tested the water activity, pH values, and use of preservatives for 61 vacuum packed soy products on the market, guided 30 vacuum pack soy product companies, and visited 13 vacuum packaging supplier factories to ensure the safety and labeling of soy products. In total, we handled 118 applications this year for testing and certification, and a total of 70 products have already been certified.

Also, the *Clostridium botulinum* outbreak traced back to bean curd from the traditional soy industry impacted the output value of bean curd. Thus, through visits to the factories, we researched and proposed the plan "Development of Technology for Healthy Value-added Protein Foods." This will help companies develop vacuum packaged, sterilized, and ready-to-eat bean curd with sensory qualities similar to non-sterilized bean curd. Research shows that by controlling commercial sterilization standards and bean curd water content, we can improve the quality of the product in terms of hardness, chewiness, and its sensory qualities. Adding cross-linking agents helps to control the Maillard reaction and also helps to improve the product in terms of hardness and its sensory qualities

8. ISO 22000 certification services

In 2010, FIRDI was put in charge by the Taiwan Accreditation Foundation (TAF) of the food safety management system (ISO 22000) as the organization handling certification. Currently, we are authorized to certify members of the frozen meat industry, dairy industry, canned food industry, alcoholic beverage industry, legume processed food industry, and miscellaneous uncategorized food industries. We are also actively adding other certification categories (the dehydrated food industry, seasoning industry, noodle industry, tea processing industry, food wholesale and retail industry, and candy and baked foods industry). For more information, visit FIRDI's website.

9. The establishment of the EHEDG, Taiwan Chapter

FIRDI invited Mr. Knuth Lorenzen, the president of the European Hygienic Engineering & Design Group (EHEDG), to Taiwan and signed a contract establishing the EHEDG Taiwan Chapter (Fig. 1). The Southern Taiwan Service Center of FIRDI will cooperate with the EHEDG to enhance the hygienic design of the food machinery industry in Taiwan in order to comply with European regulations (EC Directive 2006/42/EC for Machinery, EN 1672-2 and EN ISO 14159 Hygiene requirement).

10. Processed foods traceability system

This year, we added canned foods, flour products, and soy products to the processed foods traceability system. Currently, the system includes the following food categories: dairy products, bottled water, beverages, grain

Fig. 1. Mr. Knuth Lorenzen, President of EHEDG and Dr. B. Barry Yang (right), Director of Southern Taiwan Service Center of FIRDI, signsd a contract establishing the EHEDG Taiwan Chapter.

processed foods, meat processed foods, and fats. We are evaluating the addition of condiments, honey, snack foods, frozen foods, refrigerated prepared foods, ice products and health foods.

After the plasticizer incident this year, the Department of Health (DOH) was put in charge of drafting food traceability regulations, and due to the "draft of administrative rules regarding food traceability and tracking management", three company workshops were held. Meanwhile, there will be a phased transformation of the FIRDI Processed Foods Traceability Network mission at the end of 2012 in accordance to DOH policies.

II Promotion and Guidance of the Food Safety and Quality System

1. Promotion and monitoring of the labeling of food nutrition

Food nutrition labeling may enhance consumer awareness and understanding the contents of nutritional ingredients in food. A total of 5024 information of food companies who participated previously organized seminars and data from marketing research were collected. Suitable labeling type per service for different food categories were referenced to international formulation. The allowable variation of vitamins and minerals labeling of packaged vitamin and mineral tablets and capsules on the market have been compiled and recommended. Four hundred labeled foods were sampled for their compliancy to nutrient labeling regulation. Consensus meetings were held for the officers and food manufactories to help advocate the policy and assist in correct labeling.

2. Integration and development of the food nutrition composition database

Food nutrition composition database is important not only for the research of dietary and health, but also as a source of nutrition information for consumer. The contents of food composition database were expanded and revised. Eighty items of food were analyzed for proximate composition, minerals, vitamins, amino acids, fatty acids, cholesterol, dietary fiber and sugars. Published fish and shellfish product database and food nutrition composition database were confirmed and revised continuously.

3. Evaluation and market monitoring of nutrients for infant formula and follow-up infant formula

Methodologies on the analysis of 5 nutrients including vitamin D, vitamin K, Pantothenic Acid, inositol, and chloride were collected and evaluated. The summarized information and analytical data were fully discussed by committee meetings. Finally, a total of 11 analysis methods for these 5 nutrients and the value allowed for deviation between the labeled and measured amount were suggested. The finalized information can then be used by Department of Health as a reference guide for further policy making.

4. Database on the risk assessment of food safety

Database on risk assessment of food safety is important for both government and consumer to understand and manage the risk of chemical hazards and food pathogen to public health. In 2011, reports on 180 chemical/microbial hazards of food were revised and 80 hazards newly completed. Both professional and general versions of the database exist. Besides, 30 quality management regulation related document were also translated to Chinese language for risk communication reference.

5. Microbial quality survey of the ready-to-eat cooked foods, cold noodles, beverages and ice products

A total of 280 samples of ready-to-eat products were randomly sampled from the north, central and south regions of Taiwan. Among the samples tested 78.1% and 38.5% of the traditional cold noodles and ice products contained more than 1000 MPN/g of coliform. The major sources of microbial contamination were the improper hygiene operation of personnel; raw and cooked food materials crossover storage; unclean food containers; incomplete disinfection and wash of the food contact surface. After improving, the coliform count illegal rate has reduced to less than 5%.

6. Management and guidance for food factory raw material optimization

In order to improve food factory raw material management systems, we collected information on recent abnormalities in Taiwan food factories and performed an analysis. We managed the abnormal raw materials and drafted a raw material management system suitable for Taiwan that set up the testing and storage standards for two types of raw materials (granulated sugar and butter) for food companies to use as a reference. We also guided food factories in establishing and implementing an optimal raw material management system.

02

/Industry Service/

Technical Service and Training

1. Analysis and Services

The chemical analysis service catalogs of food includes proximate composition, nutrition content, minerals, vitamin, carbohydrate, lipid, inorganic elements, heavy metals, food additives and hazardous component , functional component, food package and water quality. The microbial examination service catalogs includes hygienic indicator microorganisms, pathogenic microorganisms, spore counts, isolation and identification of food spoilage microorganisms, microorganisms of drinking water and cosmetics, animal-derived ingredients in foods and plant-derived ingredients in foods. By continuous collection of the food analysis related information and build up of examination technique. This year, pesticide residues, plasticizer, veterinary drug residues in foods includes β-Agonists; Chloramphenicol, thiamphenicol and florfenicol, and food allergen are newly service items. Besides, pesticide residues in food and dry edible flowers, aflatoxin in food and dietary product, and heavy metal in soil are also TAF accreditation items.

2. Training industry personnel

FIRDI, using years of FIRDI research and commissions received, held industry personnel training programs on food processing, research and development, testing, quality assurance, sensory evaluation, and bioresources. In accordance to the needs of individual companies, we offer customized training programs and have special programs to go to factories and help lead training programs on site. This year, due to the plasticizer incident, we opened a "food additive management class" for students to learn the keys to food additive management and critical controls through management.

Also we trained food inspectors from various health departments across Taiwan. Due to the botulism poisoning incident, we offered a variety of classes to improve vacuum packaging instant food testing management, to gain better results from testing, and to fight the problems at the source.

This year, we offered a total of 110 classes and taught 2,648 people. Through questionnaires and surveys, our students were able to comment on how much they learned, how practical the classes were, and how the classes helped them further develop their careers. The results showed that the students learned a great deal.

3. Food technology and free advisory services

FIRDI's food technology services (including technology transfer, factory guidance, commissioned testing analysis, commissioned processing testing, and the problem product diagnoses) and application procedures may be found at http://www.firdi.org.tw/4/4.htm, "the technology services manual."

Also, to aid factories in solving issues related to processing, packaging, storage, or quality, FIRDI offers free consultation services. Companies may come in and talk to experts in person. Through communication and consultation involving actual objects, pictures of the site, educational backgrounds of personnel, and background information on raw materials and processing equipment, companies may obtain free, effective solutions to their problems. These services are open to all industries.

03

"Chart of Taiwan Food Industry and Technology History for R.O.C Centenary" published at annual meeting of TAFST, 2011.

/Industry Service/

Knowledge Services for Food Industry

1. Dynamic analysis of food industry development

Under the support of the projects of the ministry of Economic Affairs, the Department of Health and the Council of Agriculture, we have completed several survey and dynamic analysis of the development of food industry, and done communication and service outwards with various ways. The main achievement included the following.

(1) Publication of "Food Market Information" monthly, which included 1,208 papers/abstracts, and 1,081 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.

(2) Publication of "Almanac of Food Industry, 2011", 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, food machinery, and foodservices, with information of status quo of market development, trend for development, change of policy, and business dynamics.

(3) Publication of "Almanac of Food Consumption Survey, 2011", which included basis data of consumers surveyed, consumer choice of food channel, personal eating habit and demand, consumer behaviors for various foods. The almanac provides information including consumption characteristics and consumer behavior for various agricultural products and processed foods.

(4) Establishment of food material information analysis 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.

(5) More information services and sharing, included various industry surveys and research information disseminated through book publication, web presentation, E-mailing, workshop, share meeting, and seminars, to disseminate information and getting feed back. In addition to the activities of the food information knowledge club, we develop also knowledge club in specific field, including non-alcoholic beverage, to provide members with first hand information and business dynamics. In addition, we cooperate with Taiwan Association for Food Science and Technology (TAFST) to publish "Chart of Taiwan Food Industry and Technology History for R.O.C Centenary" for food industries to review past and prospect future.

2. Survey and research on food industry

We finish several publications with specially relating to Taiwan and Mainland China, including Research on operation of service models for food industry, Safety management for supply chain of food industry, Cooperation opportunities and operation models for health food industries between Taiwan and Mainland China, and Analysis of food industry in Mainland China. Meanwhile, we disseminate the information through industrial fast new report, and industrial analyzing report to provide industry information with insight instantly, hopefully to help firms to make clear the food market, law and regulation in Taiwan and Mainland China.

3. Customized knowledge service for food industries

We have finished several customized market research for food industries, including co-competition among firms, industrial value-chain structure, new products, new package, new technique, new equipment, food show information, firm and market dynamics, production, sales and trade data, consumption trend, and Taiwan and global market development. Market research reports include those in various beverages, dairy products, soy milk and cereal milk, health industry, and food machinery. The information service may help enterprises reducing time input and manpower in collection of information, and getting new and whole industry information, and 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.

/2011/

Special Report

| Cross-strait Conference on Food Industry

1. The Third Cross-strait Food Industry Cooperation and Exchange Conference

In recent years, FIRDI has aided the Ministry of Economic Affairs in promoting the cross-strait industry bridge-building project. FIRDI and the Chinese Institute of Food Science and Technology (CIFST) collaborated and co-hosted "The Third Cross-strait Food Industry Cooperation and Exchange Conference" on November 17 in the first conference room of the Taipei Train Station.

For this conference, we invited food industry personnel, experts, and scholars from both sides to participate and speak on "deepening cooperation, Chinese-style foods, and healthy consumption." Through discussions, we came to understand the visions, targets, strategies, and mechanisms of cross-strait Chinese food and health industries and looked to establishing a basis for creating new commercial opportunities.

CIFST President Su-He Meng led a PRC delegation of 39 PRC industry personnel, government officials, scholars, and experts to attend the conference. For Taiwan, over 70 industry, government, academic, and research representatives participated, with FIRDI Chairman of the Board Chung-Pi Hsieh hosting the opening ceremony. Company representatives of Taiwan who spoke during the conference included Standard Foods Chairman Ter-Fung Tsao, UPCC CEO Dong-Ho Cheng, Laurel Enterprises Corporation CEO Jamin Wang, Kokumori CEO Chia-Sheng Hsu, Chia Chia Meei Group Chairman Shi-Pei Yang, Sinphar Group COO Hui-Wen Cheng, TCI General Manager Vincent Lin, and Toong Yeuan Enterprise President David Wang.

During the conference, experts from both sides discussed a variety of issues including how the cross-strait food industry could utilize the PRC Twelfth Five-Year Plan to deepen cooperation, how to promote Chinese-style foods and traditional foods on an industrial scale, and how to promote health industry opportunities. At the end of the conference, the two sides signed a consensus statement to support cross-strait food industry development built upon past cooperation and exchange that is mutually beneficial and equally prioritizing the other side. The fourth conference will be held next year in the PRC.

Fig. 1. FIRDI Chairman of the Board Chung-Pi Hsieh (right 2) hosting the opening ceremony of "The Third Cross-strait Food Industry Cooperation and Exchange Conference".

2. Cross-strait food safety communications

FIRDI assists DOH to promote cross-strait food safety affairs via annual project. The main achievements include as follows:

1. Visiting and meetings, including 5 times of mutual visiting and meetings during 2011, focusing on functional foods, food safety, and food standards.
2. Organizing the domestic expert group, to discuss the food safety issues and provide policy suggestions for government enforcement.
3. Conducting seminars, including *Cordyceps* functional foods in Taiwan and Mainland China, foods contaminated with plasticizer issues, and food safety related topics to discuss the management and technical issues for food distribution. More than 200 personnel take part in the seminars.
4. Collecting and analyzing information, including cross-strait food safety management systems, regulations and standards, and preparation of future food safety communication plan for Taiwan and Mainland China.

Fig. 3. FIRDI Director General Shu-Kong Chen (right) and CIFST President Su-He Meng (left) signing the consensus statement.

Fig. 2. Oral presentations at The Third Cross-strait Food Industry Cooperation and Exchange Conference.

Fig. 4. Preconference picture with the 39 members of the PRC delegation.

II Establishment and Operation of Chiayi Industry Innovation and Research Center

1. Establishment

To support the development of present industrial districts in Yunlin, Chiayi, Tainan and the central and southern science parks, the Ministry of Economic Affairs (MOEA) established the Chiayi Industry Innovation and Research Center (CIIC) with the vision of building a western Taiwan industrial innovation corridor to drive the upgrading of local industries. CIIC is oriented to promotion of health and well-being by becoming a resource integrating platform for industries, government, institutes, and schools. The mission of CIIC is to develop the industry cluster in the region, paying attention to local characteristics and promoting innovative development in the health industry. CIIC got a candidate certificate for a diamond-rated green building, and will be certified as the first integrated green building in Taiwan.

2. Operation

The CIIC grand opening ceremony was held by Vice President Vincent C. Siew and Minister of MOEA, Yen-Shieng Shih, Mayor of Chiayi City, Ming-Hui Huang, Directer General of the Department of Industrial Technology, MOEA, Ming-Chi Wu, Chairperson of Central Election Commission (CEC), Po-Ya Chang, and legislator Yi-Hsiung Chiang on June 12, 2011. Four R&D centers—the Food Industry Research and Development Institute (FIRDI), Precision Machinery R&D Center (PMC), Metal Industries Research & Development Centre (MIRDC) and Cycling & Health Tech Industry R&D Center (CHC)—joined together in CIIC to provide local industry innovation and development services. In the future, CIIC aims to integrate R & D capabilities of the institutes to fulfill the innovation needs of Chiayi industries and speed the upgrading and transformation of local industrial technology.

3. Challenge

FIRDI is tasked by the MOEA with operation and R & D functions in the CIIC. The deputy director general of FIRDI, Dr. Lu-Hong Chen, is assigned as chief operating officer of CIIC, and director of Southern Taiwan Service Center of FIRDI, Dr. B. Barry Yang as deputy chief operating officer. A total of 30 staff were recruited from FIRDI's Southern Taiwan Service Center, Product and Process Research Center and Bioresource Collection and Research Center since June, 2011. The pilot plant for 125 ml health care functional beverages started full operation in June 2011. It will be a great challenge for FIRDI to integrate capabilities across all fields and facilitate innovative development of local industry and the health and well-being industry in CIIC.

Fig.5. Vice President Vincent C. Siew (left 5) and MOEA, Yen-Shieng Shih (left 4) led honored guests to attend the CIIC grand opening ceremony.

Fig.7. Outlook of Chiayi Industry Innovation and Research Center.

Fig.6. The advanced beverage filling system (above) and blending system (below) are built in the pilot plant of CIIC by FIRDI.

III Fast Response to the Plasticizer Incident

1. Providing food safety analysis services for plasticizers

A critical food safety incident involving plasticizer occurred in May 2011. Subsequently, FIRDI established the ''Plasticizer Analysis Service Team'' to actively assist competent domestic authorities and food and biotechnology-related vendors in detecting plasticizer content within foods. Approximately 4800 samples were detected, and the team assisted the food industry in rapidly acquiring safety certification. In addition, ''Plasticizer Testing Report'' export certificates were issued throughout the export industry, providing complete consulting services to assist in completing product export operations. For inconclusive samples, various analysts performed a second round of testing to ensure accuracy in the testing data. To satisfy the large-scale testing requirements of the industry, FIRDI purchased an LC/MS/MS, which was added to the testing services in the middle of June. The Taiwan Food and Drug Administration (TFDA) performance test assessed this institute as "satisfactory," indicating that the plasticizer testing capacity and the analysis results are reliable.

During the period when this incident occurred, FIRDI took the initiative in communicating and coordinating with the TFDA on standard purity, sources, and method assessment, and assisted the government in understanding and monitoring the situation of plasticizer in commercial products. We also assisted the TFDA in undertaking food plasticizer contamination source background assessments, investigations of the environmental and process contamination of food factories, and testing and analysis for plasticizer dissolving from foods and packaging in the program for monitoring plasticizer content in commercial packaged foods as well as researching and establishing standards for construction of food additive factories and equipments. In addition, assisted the Industrial Development Bureau's food good manufacturing practice (GMP), the Council of Agriculture's Certified Agricultural Standards (CAS), and the National Treasury Agency's

2011 National Food Safety Conference.

Alcohol Product Certification System in performing monitoring on quality verified food, effectively conducting quality assessments on guaranteed quality products.

2. 2011 National Food Safety Conference

Taiwan burst out the news of food clouding agents contaminated with Phthalates, which damage Taiwan food safety image in late May, 2011. Then, the Department of Health (DOH) entrusts FIRDI to call industrial representatives, government representatives, and academic authorities to hold "2011 National Food Safety Conference" from June 21st to 22nd. More than 470 personnel take part in the conference and generate collective wisdom and a lot of useful ideas to review Taiwanese food safety control system and food additives management system. The main results include:

(1) Reconstructing consumer confidences in Taiwan food safety via enforcement of concrete proposals derived from the conference in field of ''industrial upgrading'', ''policy coordination'', and "social responsibility".

(2) Reforming food management system via food product and additives classification, management, labeling, auditing, and inspection to enhance the management for all food additives. Further more, enhancement of firm-self management system, strengthening of food additive register system and related inspection capability, carrying out the food traceability system, and revise of regulations up to date may help to upgrade the management of food industries and food additives industries. Hopefully, the following actions may help Taiwan to restore consumer's MIT image in Taiwan food products.

3. Holding a forum for President Ma and Food GMP companies

The plasticizer food pollution incident greatly impacted the reputations of producers. In order to reduce concerns by consumers about GMP foods and regain their faith, FIRDI collaborated with the Industrial Development Bureau (IDB), Ministry of Economic Affairs (MOEA) and the Taiwan Food GMP Development Association to hold the "Food GMP Producer Forum for Increasing Food Safety" on July 3, 2011. A total of 51 representatives from the main food GMP companies attended. Meanwhile, government representatives included Deputy Secretary-General to the President Bao-guey Liu, MOEA Minister Yen-Shiang Shih, IDB Director General Dr. Tyzz-Jiun Duh, Food and Drug Administration Director General Jaw-jou Kang, and Hsinchu City Mayor Ming-tsai Hsu.

President Ma went in person to the conference and discussed with food GMP companies the current difficulties that the food industry needed to overcome and the possibilities for future development. Taiwan Food GMP Development Association Chairman Ying-Chung Wei represented the food GMP companies in presenting the food safety declaration, where food GMP companies vowed to President Ma and the people of Taiwan that they would increase self-management, strengthen source management, implement a foods traceability system, and increase the penetration of food GMP on the market. Also, the food GMP companies published the "Food GMP Companies Statement on Increasing Food Safety", in which they vowed to prevent future incidents such as the plasticizer incident using the specific methods stated within.

President Ma strongly affirmed the hard work that food GMP companies have put in over the past few years to improve Taiwan's food industry quality, health, and safety. He also reminded how the plasticizer incident once again showed the importance of quickly putting a food production traceability system into place and having transparency in all related information. President Ma expressed that he had already asked MOEA to speed up its implementation of a system that ensures food safety and quality. President Ma then showed how a smart phone could be used to scan a product barcode and search for the GMP food production traceability and certification report. He also interacted with the company representatives at the food GMP tasting area.

2011 National Food Safety Conference.

At the conference, President Ma emphasized the importance and urgency in comprehensive implementation of food safety and quality assurance (top left picture). During the conference, FIRDI Director General Shu-Kong Chen gave a presentation (top right picture). FIRDI Chairman of the Board Chung-Pi Hsieh (bottom picture, fourth from the right), President Ma, and representatives from all fields and industries all support the consensus statement for strengthening food safety amongst food GMP companies.

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FIRDI's Accomplishments

Plasticizer analysis service team of FIRDI's Analysis Reaserch and Service Center received a Special Contributions Award from the Mr. Hsieh Cheng-Yuan Food Technology Development Foundation (above). Bioresource circulation and value adding service platform team of FIRDI's Bioresource Collection & Research Center received the Innovation Award from the Mr. Hsieh Cheng-Yuan Food Technology Development Foundation (below). Both of these prizes were presented by Chairman Chung-Pi Hsieh at FIRDI's 44th anniversary activities.


1


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Researcher Shu-Chen Huang (above) received the "Food Science Technology R&D Achievement Award" and researcher I-Chin Wang (middle) and technologist Yung-Hua Rau received the "Extension and Service Achievement Award" from the Taiwan Association for Food Science and Technology (TAFST). They received their awards on December 2 at the TAFST Annual Conference.

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FIRDI's Four Year Research Project of Food and Bio-products Process Equipments Development (2/4) received the "Value-addition for Traditional Industries Award" from the Technology Development Programs of Ministry of Economic Affairs on December 9 at the 2011 Ministry of Economic Affairs Event for Honoring Industry Innovation held in New Taipei City. Project Leader Dr. B. Barry Yang (left 3) represented FIRDI in receiving the award.


6

2011 Activities

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Activities

January

1/20 Held a technology transfer signing ceremony, Dr.Shu-Kong Chen, Director General of FIRDI and Mr. Liang Tien Lin,General Manager of Banten Co., Ltd., signed a technology transfer contract.

1/25 Mr. Feng Hsu, Secretary General of Beijing Food Institute, led a team to visit FIRDI.

1/26 Held a technology transfer signing ceremony, Dr. Shu-Kong Chen, Director General of FIRDI and Mr. Hsi-Te Chang, President of Fresh-Catcher-Biotech Co., Ltd., signed the contract.

February

2/10 A tea party was held for the retirement of Ms. Ping-Ping Chang, Deputy Director of Food Analysis Research and Service Center.

March

3/4 Dr. Joseph Jen, former Vice Minister of the US Dept. of Agriculture, visited FIRDI.

3/22 Announcement meeting of FIRDI's research achievement of 2011 and initiation of cooperation projects among industries and FIRDI was held in Hsinchu.

April

4/18 Professor Muyi Cai, President of China National Research Institute of Food and Fermentation Industries, led a team to visit FIRDI.

4/19 Held a Cooperation and Interaction Conference with China National Research Institute of Food and Fermentation Industries in Hsinchu.

May

5/6 Held the seminar on merchants stationed of Chiayi Industry Innovation and Research Center and research achievement exhibition of stationed legal entities in Chiayi City.

5/25 Mr. Chih-Min Su, General manager of Beijing Yiqing Co., Ltd., and Mr. Chau-Hsiang Chang, chairman of Taiwan Premium Agricultural Products Development Institute, visited FIRDI.

June

6/24 Mr. José Luis Esperón, Vice President Executive for National Bureau of Technology, Argentina, visited FIRDI.

6/28 Mr. Chien Tu, Director of Chongqing Bureau of Quality and Technology Supervision, visited FIRDI.

6/29 Mr. Chih-Wei Kuo, Deputy Director of Dept. of Rural Science and Technology, Ministry of Science and Technology of the People's Republic of China, visited FIRDI.

July

7/5 Dr. Nguyen Thi Hoai Tram, Vice-Director of Food Industries Research Institute, Vietnam, led a team to visit FIRDI.

7/10 Dr. Koichi Watanabe (left 3) and Mr. Kazunori Matsuda (left 2), Yakult Central Institute for Microbiogical Research, Japan, visited FIRDI.

7/15 Mr. Po Liao, Deputy director of Hebei Science and Technology Department, led a team to visit FIRDI.

7/21 FIRDI joined the Taiwan International Biotech Exhibition 2011 in Taipei World Trade Center.

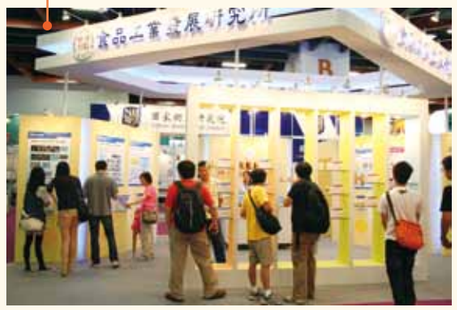
August

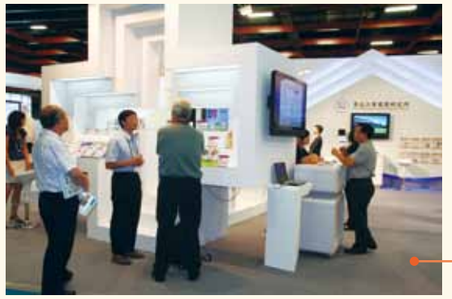
8/23 Ms. Nitiwadee Arunanurak, agricultural extension worker of Agricultural Products Promotion and Development Group, Bureau of Farmer Development, Thailand, led a team to visit FIRDI.

8/25 Mr. Dennis Bierman, Executive Director, Netherlands Foreign Investment Agency(NFIA), Taiwan Office and Mr. Vince Yi, Project Manager of NFIA-Taiwan, visited FIRDI.

8/27 FIRDI joined the Industry Counseling Exhibition and Promotion Activity which was held by Ministry of Economic Affairs in Banqiao District, New Taipei City.

8/29 Dr. Po Liu, Dean of Fujian Academy of Agricultural Sciences, visited FIRDI.





September

9/20 The opening ceremony of Chiayi Regional Food Safety Inspection Service Center was held in Chiayi Industry Innovation and Research Center. It was hosted by Dr. Ming-Ji Wu, Director General of Department of Industry Technology, MOEA and Dr. Shu-Kong Chen, Director General of FIRDI. Looking forward to providing food industry in Yunlin, Chiayi and Tainan a faster inspecting service platform.

9/21 Held Workshop of Industry Innovation on Black Fungus in Taipei.

9/29 FIRDI joined the Taipei International Invention Show & Technomart held in Taipei World Trade Center.

October

10/21 Held a technology transfer signing ceremony, Dr. Chii-Cherng Liao (left 2), Deputy Director General of FIRDI and Mr. Wei-Jen Cheng (left 3), General manager of Syngen Biotech Co., Ltd., signed the contract.

10/21 Mr. Tse-Min Chen, Chairman of China Agriculture Industry Chamber of Commerce, led a team to visit FIRDI.

November

11/5 In celebrating FIRDI's 44th Anniversary, series of activities were held.

11/20 FIRDI joined the exhibition show of 2011 International Conference on Food Factors held in Taipei International Convention Center.

11/21 Participants of ''The Third Cross-strait Food Industry Cooperation and Exchange Conference'' from Mainland China visited FIRDI.

11/23 Mr. Geoffroy Trinh, Director of International Development,VITAGORA Taste-Nutrition-Health, France, visited FIRDI.

11/24 Prof. Chien-Hsin Chao, Jiangnan University, China, led a team to visit FIRDI.

December

12/8 Mr. Chih-Kuan Chang, Director of Beijing Municipal People's Government Food Safety Supervision and Coordination Office, led a team to visit FIRDI.

12/8 Ms. Dongmei Duan, Deputy Counsel of Bureau of Food Safety Integrated Coordination and Health Supervision, Ministry of Health of the People's Republic of China, led a team to visit FIRDI.

12/21 Mr. Jian-Hua Wang, Deputy Director General of Beijing Administration for Industry and Commerce, visited FIRDI.

12/23 A tea party was held for the retirement of Mr. Wen-Liang Chen, Senior Research Scientist of Product and Process Research Center.

12/28 Whereas Asia-Pacific Biotech Developing Inc., Yen-Chen Machinery Co., Ltd., and Essential Granary Inc. formed a R&D alliance as Production of Lycogen and its Application in Cosmetics, FIRDI has also signed technology transfer contracts with these three partners, respectively.

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Food Industry Research & Development Institute
Address / 331 Shin-Pin Road, Hsinchu,30062 Taiwan, R.O.C.
Tel / 886-3-5223191 / Fax / 886-3-5214016 http://www.firdi.org.tw
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