



FIRDI 2008 Annual Report

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Preface

In 2008, the output of the food and beverage industry in Taiwan was NT\$ 527.7 billion. Although the price of the raw materials fluctuated a lot and the global financial crisis began, the output of the food and beverage industry still showed an increase of 10.5% comparing to 2007 - the highest growth rate among recent years. Apparently, the food industry is not seriously affected by the economic crisis. In a global recession, the growth of the food industry even makes a greater contribution to stabilize the economic growth and employment.

The food industry in Taiwan is regarded as the domestic-based industry. In the recent years, the domestic market has faced the trend of aging and fewer-children population structure as well as the rapid development of healthy food. As a result, the food industry started to focus on the needs of healthy diet for middle-aged and elderly people or certain particular groups. Due to the unstable supply of raw materials and leading channel price, the food industry has become a squeezed link that eagerly requires an innovation and a breakthrough.

Food safety, besides the change of the external environment, remains the primary concern in relation to food consumption. In September 2008, the Melamine incident happened in China has given a shock to the global food market. To cope with this incident, FIRDI also actively provided the detecting and analysis services and cooperated with government to support the related businesses. FIRDI has been providing all kinds of food safety services and gained public trust. Moreover, our major services have passed the ISO or TAF certification test one after another. In this year, our Microbial Detection Group institute has

shown great detecting and analysis ability by participating in the proficiency test assessment held by Central Science Laboratory of UK. In addition to that, the certification systems promoted by FIRDI, including CAS, GMP, HACCP and Wine certification, have all become important references for consumers. The promotion of the above food quality and safety systems not only assists the government in ensuring food safety, but also facilitates the link of the Taiwanese food industry around the world.

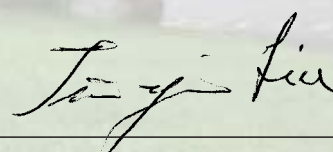
Besides, FIRDI increases the added value of food products by the health concept. Taking traditional foods as matrix and the satisfaction of consumer needs as presumption, FIRDI formulated various technological platforms for adding value to food and made significant advances and breakthroughs in vegetarian meat processing technologies, minimal processing technologies, nanon processing technologies, manufacture and application technologies for functional ingredients, safety evaluation and functional assessment technologies, integrated technologies of food machinery and manufacturing, and food serving technologies. For example, the multi-functional GSH technology has been transferred and reached to the investing stage after making the effort for many years. Moreover, the product includes both blood sugar and blood lipids adjustment functions developed by the functional assessment platform has been sent to apply the patent that has been expected by all business fields. On top of that, the application of the microwave drying system on the non-fried instant noodles has been commercialized and the test result was also excellent.



The Bioresource Collection and Research Center (BCRC) at FIRDI is a world level bioresource center. It has built a solid foundation for the development of Taiwan bio-industry. It is also one of the worldwide leading industrial oriented bio-resource centers. The achievements of BCRC over the past 25 years are highly recognized. The *Monascus* related research and development is one of the significant cases. In 2008, FIRDI was invited to host the International *Monascus* Symposium. FIRDI is expected to lead the *Monascus* industry to innovate the value-added concept and create new opportunities through the strain improvement and production technologies of *Monascus* spp. and the worldwide leading researches based on whole genome sequencing of *Monascus pilosus*. The research of the culturing and freezing preservation technology of the corneal-limbus stem cell won the 2008 Troutman Award of Coneal Society of USA, demonstrates the outstanding capability of the innovative stem cell research at FIRDI. In the recent years, the fermentation banks constructed based on the "Innovative and value-added bio-resource application" strategy has been highly valued by the bio-industry with great application potential in the future.

"Research, Development and Innovation" is the concept that has been shown on the institute badge since 41 years ago to thank the founder of this institute Mr. Hsieh Cheng-Yuan and other early contributors for their efforts of creating this concept and contribution to the industry. This institute would like to express our gratitude to Hsieh Cheng-Yuan Foods Technology Development Foundation for the support and sponsorship of establishing the "Hsieh Cheng-Yuan Special Contribution Award" and "Hsieh Cheng-Yuan Innovation Honor Award" in 2008 which have become the highest honor of our institute's annual awards. It is expected that all our members will make contribution and seek for winning the awards.

Gratefully, the self-raised fund of our institute first time broke the 40 years record - two hundred million in 2008 after making a full effort for many years. Indeed, how to become an international-level food and bio-resource research institute with high industrial innovation ability is a dream that all our members are working hard to fulfill. In the future, our institute will keep up with the industrial development trend more accurately and swiftly to meet the industry needs and promote the sustainable development of the industry and our institute. Hopefully, all parties concerned will continuously give their wholehearted encouragement and support to our institute.



Tin-Yin Liu, Ph.D.
Director

Activities



March. 3 Dr. Tin-Yin Liu(left), Director of FIRDl, and Mr. Charles Brand(right), General Manager of Tetra Pak Co., signed an entrusted research contract.



March. 13 Dr. Locksley E. McGann, Univ. of Alberta, Canada, visited FIRDl.



March. 18 Announcement meeting of FIRDl's research achievements in 2008 and initiation of cooperation projects among industries and FIRDl was held.



March. 21 Dr. Kenneth K. Wu, President of National Health Research Institutes, led a team of 15 to visit FIRDl.



April. 8 Mr. Justin B. Bayili, Director General, Office National the Commerce Exterior, Burkina Faso, led a team of 7 to visit FIRDl.



July. 6 Series of activities were held for the Dragon-Boat Festival.

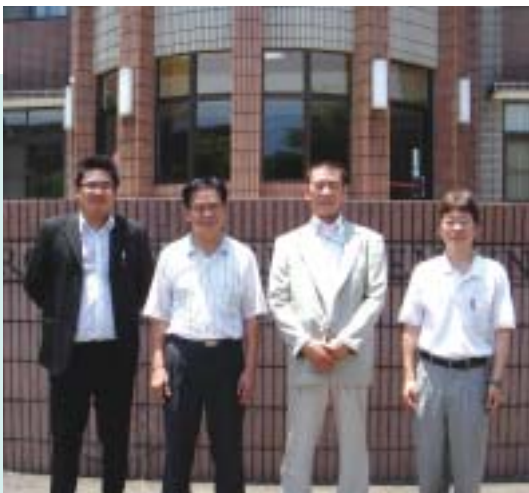




June. 18 FIRDI and Aeronautical Systems Research Division of Chung-Shan Institute of Science & Technology organized a Research Alignment of Bio-foods Separation Equipment and signed a cooperation agreement in Taipei.



June. 18 FIRDI joined the 18th Taipei International Food Show in Taipei World Trade Center.



June. 20 Professor Ando Koichi, Hokkaido Rakuno Gakuen University, Japan, visited FIRDI.



July. 21 Mr. Hung-Wei Wan, Chairman's Assistant, Shineway Group, China, visited FIRDI.



July. 24 FIRDI joined the Taiwan International Biotech Exhibition 2008 in Taipei World Trade Center.





Aug. 19 The Legislator's assistants of the Legislative Yuan, R.O.C. and Ms. Mei-Hua Wang, Director General of Intellectual Property Office, Ministry of Economic Affairs, visited FIRD.



Aug. 20 Mr. Max Chauvet, Mr. Frantz Duval, and Mr. Samuel Baucicaut, Journalists of Le Nouvelliste, Haiti, visited FIRD.



Sep. 25 FIRD joined the Taipei International Invention Show & Technomart held in Taipei World Trade Center.



Oct. 3 Dr. Jian Chen, President of Jiangnan University, led a team of 8 to visit FIRD.



Oct. 17 Participants of APEC/ATCWG Workshop visited FIRDl.



Oct. 21 Prof. Dr. Meinolf G. Lindhauer, Head of Department of Safety and Quality of Cereals, Max Rubner-Institut (MRI), Germany, visited FIRDl.



Oct. 22 Dr. Tin-Yin Liu attended the starting ceremony of “Technology Innovation for the Local Industry of Ministry of Economic Affairs” held in Southern Taiwan Innovation and Research Park, Tainan.

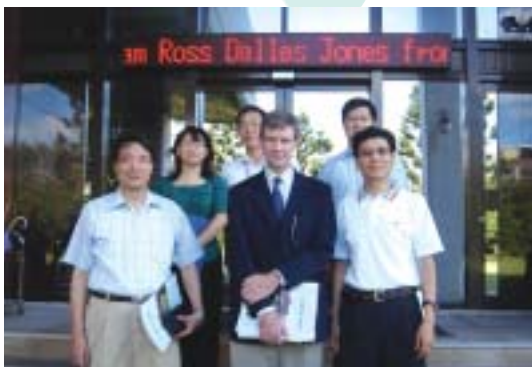


Oct. 30 Held “R&D Alignment Conference of Ultrasonic Extraction Equipment”, FIRDl, Uni-President Group, Taiwan Chlorella, Yenchen Machinery Co., Ltd., Yong Jian Co., Chung-Shan Institute of Science & Technology signed a cooperation agreement in Hsinchu.

41th Anniversary



Nov. 1 In celebrating FIRDI's 41th Anniversary, a series of activities were held, Chemical Analysis Group of Food Analysis Research and Service Center and Southern Taiwan Service Center were awarded a distinction prize and an innovation prize by Cheng-Yuan Hsieh Foundation.



Nov. 4 Dr. Graham R. D. Jones, Senior Staff Specialist in Chemical Pathology, St Vincent's Hospital, Sydney, Australian, visited FIRDI.



Nov. 24 Mr. Qing-Hou Zong, Chairman of the Board Cum General Manager, Hangzhou Wahaha Group Co., Ltd., and Hsih-Chung Tsao, C.E.O. of Taiwan Hon Chuan Group, led a team of 21 to visit FIRDI.



Dec. 16 FIRDI sponsored "2008 International Symposium on *Monascus*" held in Taipei.



Dec. 17 Hon. Mr. Tuan Yaakob Bin Sapari, Executive Council Modern Agriculture Method, Natural Resources and Entrepreneurs Development of Selangor, Malaysia, led a team of 24 to visit FIRDI.



Dec. 25 A tea party was held for the retirement of Dr. Keh-Ming Chiou, Head of Technical Service and Extension Center and Mr. Ping-Yang Chang, Associate Head of Product and Process Research Center.



Dec. 19 Speakers and Attendees of "2008 International Symposium on *Monascus*" visited FIRDI.



Dec. 22 Ms. Sheau-Ming Dong, Vice Dean of the School of Rural Village Research and Development, Shanghai Jiao Tong University, led a team of 6 to visit FIRDI.

Product and Process Research Center



Physiological benefits and quality have become the vital parts in consumers' decision for food purchasing and surely the emphasizing points in new product development of the industry. The Center had focused on the screening and upgrading of functional properties from processed foods and ingredients, and dedicated on the physical property improvement on texturized-vegetable-protein (TVP) based products and development of moduled meal system for retail outlets. Researches included the application of dietary fiber and nanotechnology for functionality enhancement in fruit and vegetable juices, usage of fermentation to improve antioxidative properties of citrus peels, and masking stinking taste of functional ingredients with microencapsulation. In addition, the Center also worked on the functional assessment of foods and ingredients towards cardiovascular protection, improvement on insulin resistance, and induction of phase II detoxification/antioxidant enzymes. In the quality improvement researches on TVP based products, the Center developed a new formulation of vegetable binder and a new mechanical design on twin-screw extruder that significantly enhanced the texture properties and organoleptic qualities of the products.



Product and Process Research Center

I. Functionality Enhancement for Processed Foods and Ingredients

1. Development of vegetable and fruit juices containing dietary fiber for improvement of intestinal physiology

Enzymatic hydrolysis on post-pasteurization carrot puree was conducted in the hope to produce a hydrolyzed whole-fruit carrot juice with superior cloudiness stability, meticulous mellow taste and excellent palatability. Dietary fiber content of the hydrolyzed whole-fruit carrot juice was 0.96% which was higher than that of the non-hydrolyzed marc-removed carrot juice (only 0.05%). Although the hydrolyzed whole-fruit carrot juice contained 20% less dietary fiber than non-hydrolyzed marc-containing carrot puree (1.20% dietary fiber content), it tasted better. In order to understand the beneficial effect of the juices on intestinal physiology, we conducted an *in vitro* experiment by incubating feces of Sprague-Dawley rats with the juices to simulate the fermentation in large intestine. Results showed that amount of total short-chain fatty acids (C2-C4) formed was 40.7 (mole/g) with the hydrolyzed whole-fruit carrot juice, while those were 33.4 and 26.7 (mole/g) with non-hydrolyzed marc-removed carrot juice and non-hydrolyzed marc-containing carrot puree, respectively. A four-week feeding experiment on Sprague-Dawley rats also revealed a reduction on fecal β -glucuronidase activities. The reduction were 62, 61, and 39% for the hydrolyzed whole-fruit carrot juice, non-

hydrolyzed marc-removed carrot juice and non-hydrolyzed marc-containing carrot puree, respectively, as compared with that of Sprague-Dawley rats being fed with saline. In addition, the concentrations of total fecal short chain fatty acid (C2-C4) were similar to those of Sprague-Dawley rats being fed with either hydrolyzed whole-fruit carrot juice or non-hydrolyzed marc-containing carrot puree but were about 10% higher than those from rats being fed with saline or non-hydrolyzed marc-removed carrot juice. The total aerobic bacteria count of the hydrolyzed whole-fruit carrot juice remained at less than 10 CFU/ml and no significant flavor change was observed after storage at 7°C for 14 days. However, the dietary fiber content was reduced by 20%. Furthermore, a 250 kg batch of hydrolyzed whole-fruit carrot juice was continuously packaged with a pilot-plant scaled aseptic equipment. The juice products did not show obvious changes on pH value and flavor after 14-day storage at 40°C.

2. Effects of fruit/vegetable microparticles on the regulation of plasma glucose and lipid

Microparticulation has been used in Hippocratic juices to improve the appearance, mouthfeel and shelf life of the juices (Fig. 1). It is of great interest that whether microparticulation has the ability to enhance the physiological functions of Hippocratic juices. In this study, beneficial effects of fruit/vegetable microparticles on the regulation of plasma glucose and lipid was evaluated with *in*

vitro model experiments. Broccoli, bitter gourd and guava were particulated with different methods to obtain particles with average size ranging from 1.7 to 12.7 μ m. Results showed that the smaller particles of broccoli and guava the better their glucose adsorptability. Microparticles of the three samples also showed ability to retard the dialysis of glucose. However, only broccoli revealed strong negative correlation between the retardation and particle size. On the other hand, all the fruit/vegetable particles were able to inhibit the activity of α -amylase, but the inhibition did not show correlation with the particle size. Additionally, physiological effects on plasma lipid metabolism of different sizes of carrot, apple, American celery, Chinese yam, broccoli, bitter gourd and guava particles were also studied. Cecum contents of Sprague-Dawley rats were incubated with the fruit/vegetable particles for a period of time and the microbial floras and short-chain fatty acids were assayed. Moreover, cholic acid binding capacity of the fruit/vegetable particles at mimic intestinal

environment was also conducted to estimate their ability in plasma lipid regulation. Results showed that carrot, apple, and Chinese yam particles had higher predictive index on sterol metabolism, which suggested a higher ability in plasma lipid regulation. However, effects on plasma lipid regulation of the fruit/vegetable particles seemed do not have correlation with particle sizes.

3. Reduction of purine contents in mushroom extracts

Mushrooms are very popular in Taiwan because they are highly nutritious and contain bioactive ingredients for human health. However, mushrooms are also high in purine content that renders them not acceptable by people suffering from gout. In this study, we established a fermentation technology to reduce the purine content of mushroom extracts. Biodegradation of purine in mushroom extracts was investigated in both 5-liter and 250-liter scales. Experiments at 5-liter scale with this developed technology showed that purine content of *Flammulina velutipes* extract was reduced by 88.1%, *Pleurotus ostreatus* extract by 69.9%, *Lentinula edodes* extract by 88.9%, *Agaricus bisporus* extract by 42.1%, and *L. edodes* stalk extract by 75.3%. A scale-up experiment at 250-liter scale was also conducted on *L. edodes* extract. Purine content of the *L. edodes* extract was reduced by 74.1% after 48 h of fermentation. Besides, sensory evaluation on aroma, flavor and mouthfeel did not show significant differences between fermented and un-fermented extracts.

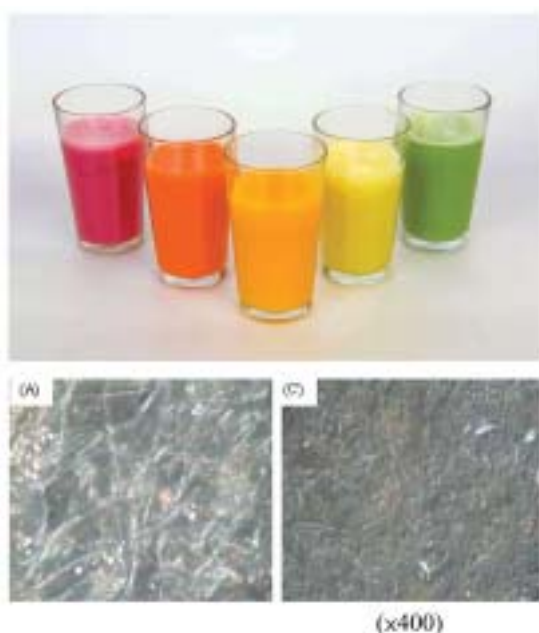


Fig. 1 Microparticulated fruit/vegetable juices

4. Application of fermentation technology on citrus peels processing

This study aimed to develop fermented citrus peel juices with higher antioxidative capacity. Orange or lemon peels were used as the experimental materials. The peels were cut into 1 cm × 1 cm before hot processed at different temperature and time, and were then inoculated with bacterial strain of either filamentous fungi or lactic acid bacteria. Several strains, as revealed high antioxidative activity on the fermented citrus peels, were selected for further investigation. Flavored water or passion fruit juice drink were formulated by blending the above fermented citrus peel juices with water or passion fruit concentrate. It was found that orange and lemon peels fermented with *Aspergillus* A12 and A14 showed higher antioxidative capacity. TEAC, ORAC and polyphenol contents in orange peels fermented with A12 and A14 were 28~30, 3.4~3.5 and 2.6 times those of control. Similar results were also observed in fermented lemon peels with 10~12.5, 1.8~2.1 and 2.2~2.5 times in TEAC, ORAC and polyphenol contents, respectively. Polymethoxyflavones in fermented orange peels were also increased with nobiletin showed 1.46, sinensetin 1.22, tangeretin 1.24 and tetramethoxyflavone 1.22 times those in control. These results indicate that fermentation with *Aspergillus* is quite effective in increasing the antioxidative capacity of orange and lemon peels. The functional properties and flavor of the flavored water and passion fruit juice drink were also retained after 4-week storage at 4°C.

5. Encapsulation technology for taste masking of DHA

Because of the growing health awareness and aging population, functional ingredients with physiological activity attracted much more attention recently. However, many of them, such as astaxanthin, lutein, DHA, and EPA, are unstable and susceptible to degradation or generation of unpleasant odor by light, heat and oxygen. Microencapsulation is one of the effective ways to protect these functional ingredients. It could improve the stability of the functional ingredients during processing and storage and mask the unpleasant odor for suitably incorporating into different foods.

In this study, DHA was used as a model compound for preparation of microparticles by spray gelation, immerse adsorption followed by surface modification. The size of the microparticles ranged from 100 to 200 µm. The yield was 80-85% and the payload was more than 25%. Retention of DHA was higher than 90% and no obvious spherical change on the microparticles was found after the microparticles were added into 90°C water and maintained at 50°C for an hour. Digestion tests showed that total DHA release was more than 70% with simulated gastric fluid (1 hr) and intestinal fluid (2hr). Stability and organoleptic preference of three different microparticles were compared. They were prepared by spray gelation/immerse adsorption, spray gelation/immerse adsorption/film coating or spray gelation/immerse adsorption/surface modification. Results showed that the release of propanal from the three different microparticles

was 0.71, 0.19 and 0.02 ppm, respectively, after 6-month storage at room temperature. Sensory evaluation of multigrain hot drinks added with different microparticles indicated no significant differences among these microparticles with respect to flavor, mouth-feel and overall acceptance. Nevertheless, DHA microparticles with spray gelation/immersely adsorption/surface modification had the highest sensory scores. It was therefore concluded that microencapsulation of DHA by spray gelation/immersely adsorption/surface modification had a better effect on protecting DHA from oxidation and masking the fishy off-flavor of DHA. The microparticles were suitable to be incorporated into hot drinks.

6. Effects of soy nutrition peptides and satiety peptide precursors in weight loss

Many modern day chronic diseases are caused by obesity, such as type 2 diabetes, hypertension and heart disease. Weight loss is the only way to prevent these complications caused by obesity, but how to lose weight in a healthy way is critical to its success. Our group

had developed several kinds of bioactive soy peptides for weight management. In order to investigate the influence of bioactive soy peptides on weight loss, soy-derived peptides effective in satiety induction and maintaining nitrogen balance were supplied with calorie reduced diet in weight loss phase for two months. The satiety peptide precursors were added to rice, the energy provided in the daily diet is ca. 1500 Kcal for 100 obese subjects. Results revealed that approximately 5 % of the body weights were reduced (mostly fatty substances) after 8 weeks period. Besides, body mass index (BMI), waist circumference, and percentage of body fat were all significantly decreased. Reduced levels for blood pressure, plasma lipids, GOT, and GPT were also witnessed. In addition, measurement of visceral fat by MRI (magnetic resonance imaging) has shown a 7.11% reduction of thickness of the fatty layer (Fig. 2). These data suggest that calorie reduced diet with bioactive soy peptides is a safe and healthy practice of weight loss program.

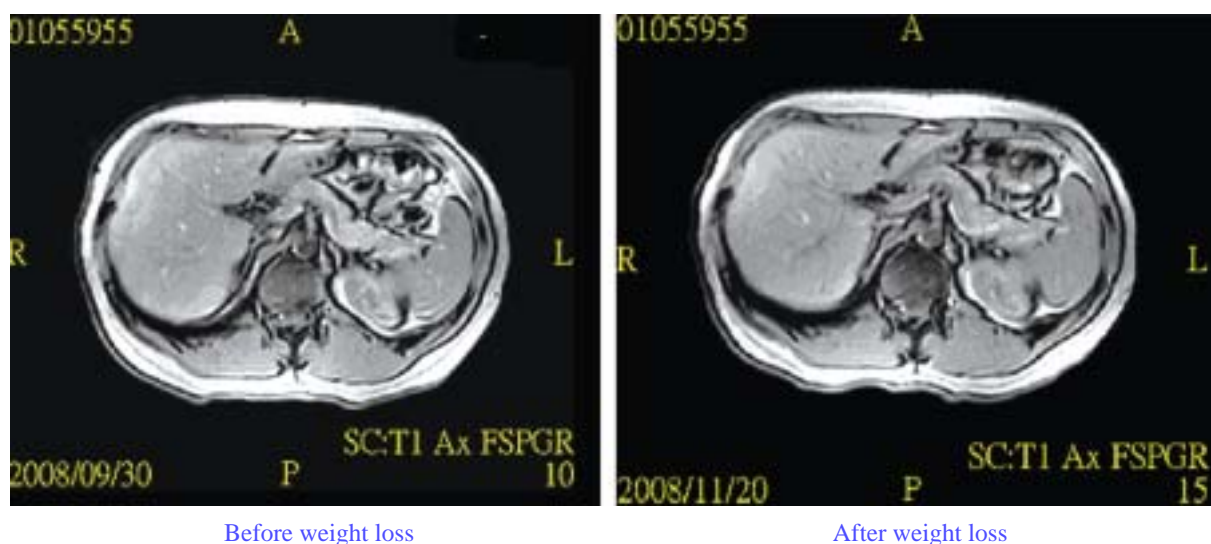


Fig. 2 Magnetic resonance images

II. Nutraceutical and Functional Property Probing on Foods and Ingredients

1. Studies on cardiovascular protection and antiaging properties of foods derived from fermentative extracts of legumes and cereals

Cardiovascular diseases and stroke are the top three major causes of death in Taiwan. The complications of atherosclerosis often lead to death. This evidence implicates that preventing the occurrence of atherosclerosis may help maintaining normal cardiovascular function. With progress in living standard and medical treatment, Taiwan had gradually marched toward an aging society in recent years with rising number of patients suffer from senile dementia. Therefore, development in medical science for antiaging is eagerly in need.

The objective of this study was to investigate the effects of fermented soybean hypocotyl in regulating lipid metabolism, cellular adhesion molecule and antioxidant enzymes in hamsters fed with a high fat diet. After an 8-week feeding period, animals were sacrificed and their blood and liver tissues were

collected for assays of plasma total cholesterol (TC), low density lipoprotein-cholesterol (LDL-C), high density lipoprotein-cholesterol (HDL-C), triglyceride (TG) and intercellular adhesion molecule-1 (ICAM-1) (Table 1). Activities of hepatic antioxidative enzymes, including superoxide dismutases (SOD), catalase (CAT) and glutathione peroxidase (GSH-Px), were also measured. Results showed that serum TG was 19.5% lower with rats fed with fermented soybean hypocotyl as compared to that of the control group. There was no difference in total cholesterol concentration between the two groups, however, lag time for LDL-C oxidation in the fermented soybean hypocotyl group was significantly increased. In addition, animals received fermented soybean hypocotyl also showed decreased concentration of ICAM-1 up to 11.6%, and increased activities in SOD, CAT and GSH-Px. Therefore, the fermented soybean hypocotyl, in view of its ability in modification of blood lipid profile and hepatic oxidative status, had the potential to be developed into functional foods for the prevention of cardiovascular diseases.

Table 1. Changes on plasma biochemical values of hamsters after an 8-week dieting on fermented soybean hypocotyls.

| Item | % change |
|--|----------|
| Total cholesterol (mg/dL) | ↓ 0.1 |
| Total triglyceride (mg/dL) | ↓ 19.5 |
| Low density lipoprotein-cholesterol (mg/dL) | ↓ 6.6 |
| High density lipoprotein-cholesterol (mg/dL) | ↓ 10.3 |
| Lag time for LDL-C oxidation (min) | ↑ 11.6 |
| Intercellular adhesion molecule-1 (ng/mL) | ↓ 11.6 |
| Superoxide dismutase (U/mg protein) | ↑ 16.7 |
| Glutathione peroxidase (U/mg protein) | ↑ 16.5 |
| Catalase (U/mg protein) | ↑ 12.3 |

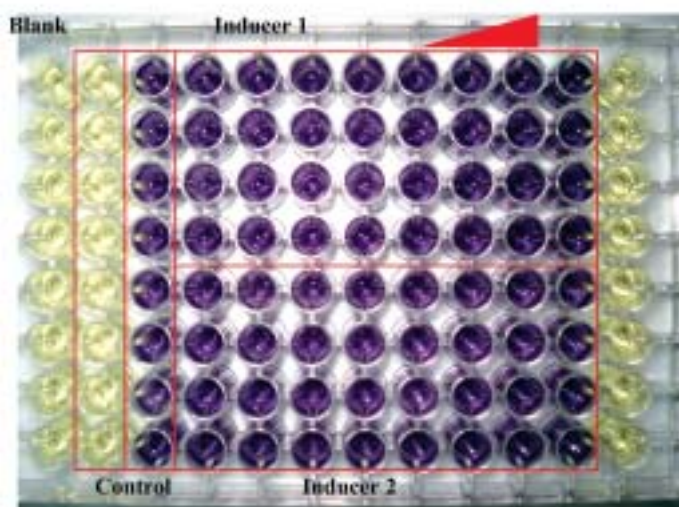
2. Potential botanicals for improving insulin resistance

Following screening for botanicals with stimulatory effect on PPAR γ activities, we continued the search for potential botanicals for improving diabetic dyslipidemia through a number of *in vitro* assays including inhibiting acetyl-CoA carboxylase activity, reducing the amounts of triglycerides of HepG2, decreasing the uptake of fatty acids and FABP4 inhibitor/ligand. A test product was formulated based on these data banks and pilot-produced for animal test and stability test. Sprague-Dawley rats were fed on 60% fructose diet to induce hyperinsulinemia and glucose tolerance. Oral glucose tolerance test was carried out after 4-week supplementation, the levels of plasma glucose at 90 and 120 min of both low and high dosage groups (94 and 188 mg/kg, respectively; 94 mg/kg for rats equal to 0.9 g/60kg person) were significantly lower than those of diabetic controls ($p < 0.05$). After 8 weeks, there were no statistical differences in AUC 120 min between the two test groups and normal control in oral tolerance test ($p > 0.05$). Both the absolute and relative weights of epididymal fats of both test groups were markedly lower than those of diabetic controls. The concentrations of liver triglycerides of high-dose group were significantly lower than those of diabetic controls. Six-month shelf-life study showed that neither acidification nor higher temperature (37°C) had adverse effects on the stability of this product.

3. A screening assay of inducing phase II detoxification/antioxidant enzymes *in vitro* for food stuffs

Oxidative stress plays an important role in cancer, aging and chronic diseases. The antioxidants, which prevent or decrease oxidative stress, can be divided into two groups of direct and indirect antioxidants. Direct antioxidants such as glutathione (GSH), α -tocopherol, ascorbic acid and carotenoids, can participate in the cellular physiological and biochemical processes directly and quench the free radicals. On the other hand, indirect antioxidants do not participate in the cellular processes. They induce some detoxification/antioxidant enzymes, for instance, Phase II enzymes, which enhance the free radical scavenging activity of cells. Some nature foods are direct antioxidants, some are indirect antioxidants, and whereas some are both direct and indirect antioxidants. Phase II enzymes, include glutathione transferases (GSTs), NAD (P)H:quinone reductase (QR), heme oxygenase 1 (HO-1), UDP-glucuronosyl transferase (UGT), play an important role in detoxification and cancer prevention.

A rapid and effective screening assay for assessing food constituents that could induce phase II detoxification/antioxidant enzymes was developed (Fig. 3). The murine hepatoma cell line was used and the activities of NAD(P) H:QR and GSTs were assayed. It was found that there were several food constituents and stuffs that can induce Phase II enzymes, for example, isothiocyanate, sulforaphane, epigallocatechin gallate (EGCG), broccoli and sesa-minol triglucoside, etc. Those can be



The increases of color (from left to right) depend on the concentrations of inducers



Foods that can induce antioxidative enzymes

Fig. 3 Illustration represents the activities of quinone reductase induced by the inducers of food constituents

indirect antioxidants and have the potential for developing into healthy foods as antioxidants or for anti-aging.

4. Development of antihypertensive functional foods from poultry by-products

Poultry by-products were used to develop functional foods in this study. This technology can solve the discarding problem of poultry by-products by changing the by-products into good sources of protein hydrolysates. At present, there is no antihypertensive functional food from poultry by-products on market. We used chicken blood powder as the raw material, which was hydrolyzed by proteases and the soluble protein, peptide content, inhibitory activity against angiotensin I converting enzyme (ACE) of the hydrolysates were studied. Optimal hydrolysis condition was screened out from using several proteases at different concentrations and time. Furthermore, active peptides in the hydrolysates of poultry by-products were separated and purified while

their identities are still under investigated now.

Results showed that a hydrolysate with the best ACE inhibitory activity was obtained by using a protease from *Bacillus licheniformis*. Soluble protein and peptide content of the hydrolysate were significantly higher than those of un-hydrolyzed. ACE inhibitory activity of the poultry by-product hydrolysate was approximately the same as that of a commercial product (katsuobushi oligopeptide), while the inhibitory activity was further improved by separation and purification processing on the hydrolysate. It is hoped that the poultry by-product hydrolysate thus developed has a potential to be used as a functional food.

III. Texture Quality Improvement on Vegetarian Meat Analogs

1. Extrusion technology for the production of imitated meat products based on wet gluten

In this study, the extrusion processing technology for the production of imitated meat

products based on wet glut en was developed. The moisture content of the products ranging from 63 to 67%, and all the products having good fibrous texture (Fig. 4,5). Two types of product were developed. The flat type had a width of 50 or 80 mm, and thickness ranging from 6 to 10 mm. The cylindrical type had diameter of 5 or 10 mm. Physical properties of the flat type product (thickness: 7.5mm, width: 50mm) showed Fv (vertical cutting force) of 5730.5 ± 610.9 g, Fp (parallel cutting force) of 2854.8 ± 264.5 g, and tension strength of 4.06 ± 0.53 g/mm². On the other hand, Fv of the cylindrical product (10mm diameter) was 4070.3 ± 251.0 g. Preference panel tests showed no significant difference on texture, flavor or total score for the flat type products with 55 and 65% moisture contents. However, significant differences were found on texture and flavor of the cylindrical products, but no difference on appearance and total score.

A six-hole circular cooling die was designed in this study. The length of the circular cooling die is 1000mm and the diameter of each hole is 10mm. Cooling water circulated independently around each hole and the water flow rate was controlled by six ball

valves. A slit cooling die for textured gluten was also designed in this study. The entrance of the cooling die is a circular pipe with 54mm inner diameter. The pipe is deformed gradually along the axis and become a rectangular shape with 80mm width and 6mm height.

2. Formulation and application of vegetable binders

The study in this year was aimed to further improve the binding ability and thermal stability of vegetable binders, and to establish technologies for the application of the binders used in various vegetarian meat analogs.

It was found that vegetable binders prepared under the suitable combination of vegetable proteins and polysaccharides in certain concentrations and proportions, had a binding strength around 83 g/cm², very close to the 86 g/cm² of whey protein binder, and could provide a good thermal stability. These vegetable binders can be applied to the manufacturing of vegetarian ham, chicken and fish products. These TVP-based vegetarian meat products had good texture and organoleptic qualities. The breaking strengths were 1300-1350g, 616-795g, 406-562g, and



Fig. 4 Flat type vegetarian meat analogs



Fig. 5 Dish with cylindrical type vegetarian meat analogs

firmnesses were 800-1600g, 1000-1310g, 459-835g for vegetarian hams, chicken chops and fish fillets, respectively. Sensory evaluation also showed the vegetarian meat products had higher quality score than those counter-parts sold in the market. It is therefore concluded that the vegetable binders developed in this study are very promising to replace the whey protein- or egg white-based binders for manufacturing vegetarian hams and other vegetarian meat products.

IV. Service System Development for Healthy Meals

This project carries on the development of healthy meals service system. Make use of a food material reorganization and modification technique to develop 2 types of meat with dietary fiber (using hot and cold gelling, develop 5 items of meat product), 2 kinds of marine product with fibers, 1 rice product line (10 kinds of different product which contain natural food materials such as cereal, legume, vegetable, tea or nut), 5 kinds of semi-finished product (to be applicable to sauces, soups, frying powders or batterings, etc.) with dietary fiber of vegetables, fruits, cereals, legumes, and

seaweed materials. All of these can be incorporated into healthy meals with rice, meat, or egg. The healthy meal was designed to contains 10 g of dietary fiber, which was 50% higher than that of regular meals. The related technique can be transferred to the food processing operators or dining service system.

An established food composition database and an information platform of foods for health care were the foundation for the meal development. The database and platform were used to build up the health information of the meals, to help an operator to mark the composition for promoting the enterprise professional image, to raise the consumption frequency of products and to satisfy the need of the customers who pay attention to their health. Through a trial operation with the preparation of 1,800 meals, we had integrated several facets to achieve a successful dining supply which included menu design, food material preparation, supply operation and marketing activity (Fig. 6). It is believed that the established dining supply system can help the operators to develop innovative products and to create new business opportunities.

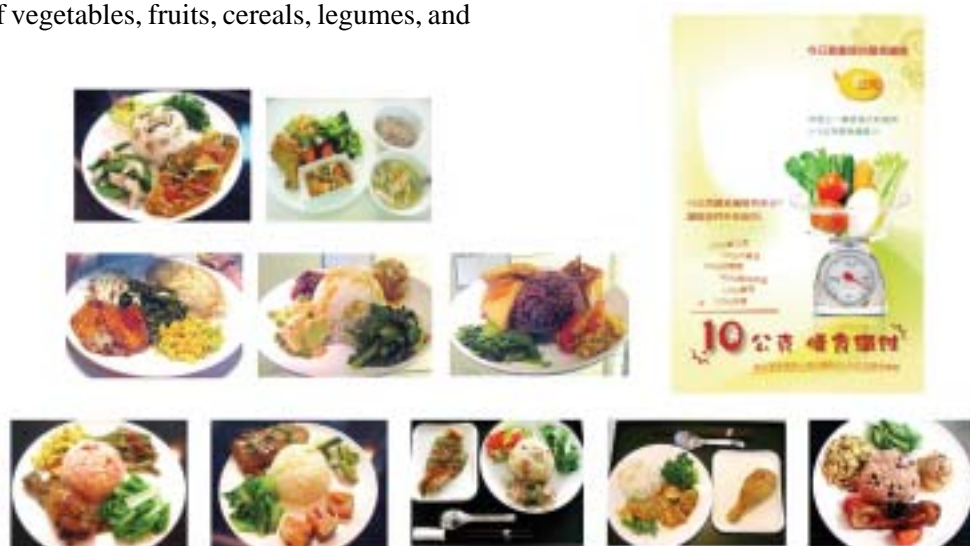


Fig. 6 Meals with high contents of dietary fiber

Bioresource Collection and Research Center



Bioresource Collection and Research Center (BCRC) maintains the quality management system of International Standard ISO 9001 and continues to offer excellent services and biological materials. BCRC has received one more certification from Taiwan Accreditation Foundation (TAF) on the isolation and characterization of *Legionella* this year. The microbial collection at BCRC has exceeded 20,000 strains, and the distribution has been over five thousand batches. After completing the *Monascus* sequencing project, BCRC was privileged to host an international conference of "Monascus 2008" on December 2008. More than 200 participants attended this conference to discuss how to transform innovative ideas into valuable products and bring new opportunities to the *Monascus*-related industry. For cell resources, BCRC has expended much effort in developing techniques to isolate and culture new types of stem cells, which may have huge potential for regenerative medicine. We have successfully developed techniques to expand and cryopreserve the limbal stem cells, resulting in a paper on *Cornea* detailing the technique. The Cornea Society/ EBAA (Eye Bank Association of American) highly recognized the achievement and innovation of the research team and honored the first author with the 2008 Troutman Cornea Prize. Collectively, BCRC will continue advancing the value of bioresources and gaining competitive advantages for industry.



Bioresource Collection and Research Center

I. Collection and Utilization of Diverse Bioresources

1. Bacterial Resources

(1) Collection of halophiles in Taiwan

A special collection of the halophilic bacteria isolated from salt environments in Taiwan had been preserved in Bioresource Collection and Research Center (BCRC). According to the 16S rRNA gene sequencing, these isolates belonged to the genus *Bacillus*, *Chromohalobacter*, *Cobetia*, *Halobacillus*, *Haloferax*, *Halomonas*, *Idiomarina*, *Marinobacterium*, *Marinococcus*, *Oceanobacillus*, *Pontibacillus*, *Pseudomonas*, *Pseudoalteromonas*, *Salicola*, *Salimicrobium*, *Salinivibrio*, *Staphylococcus*, *Thalassobacillus*, *Vibrio*, and *Virgibacillus*. *Halomonas* was the most common genus found. It comprised one-fourth of the total isolates and could be found from any samples. Based on the phylogenetic tree of 16S rRNA gene, these 50 *Halomonas* isolates were highly heterogeneous. We selected 34 isolates to evaluate their enzyme activity. Results indicate that most of the isolates contain various industry enzymes and have the potential to be exploited in the future.

(2) Classification of *Lactobacillus taiwanensis* sp. nov.

The bacterial strain, FIRDI 006^T, was isolated from the forage and characterized by phenotypic and molecular taxonomic methods.

The strain was a Gram-positive, catalase-negative, non-motile, facultatively anaerobic rods, and homofermentative lactic acid bacterium. The 16S rRNA gene sequence analysis revealed that the strain phylogenetically belonged to the *Lactobacillus acidophilus* group. The *gyrB* gene sequence analysis and DNA-DNA hybridization indicated that *gyrB* gene sequence similarities (<87%) and DNA-DNA reassociation values (11-45%) were low between this strain and the phylogenetically nearest neighbours. Based on the results of polyphasic studies, the strain is considered to represent a novel species, for which the name *Lactobacillus taiwanensis* is proposed. The type strain is FIRDI 006^T (= BCRC 17755^T = DSM 21401^T).

(3) Collection of photosynthetic bacteria

Photosynthetic bacteria contain chlorophyll, which are able to use light as energy source to synthesize heterorganic products as nutrient. They are widely distributed in aquatic environments exposed to light. These bacteria have been used in versatile industrial fields, including the processing of waste water, producing single cell protein as fertilizer, producing hormone, vitamins and enzymes, or the manufacture of biodegradable plastics and hydrogen. For various applications of photosynthetic bacteria, the collection and preservation of local photosynthetic bacteria strains in Taiwan are essential. Following last year's program, we have collected and preserved 25 diversified strains of

photosynthetic bacteria from local aquatic environments in Taiwan.

(4) Collection and identification of local osmophilic actinomycetes

In this study, 22 isolates of halophilic and halotolerant actinomycetes were isolated from various environments in Taiwan with selective media. All isolates were identified to be mesophilic-halotolerant actinomycetes, except one halophilic strain and one thermophilic-halotolerant strain. Most of the halotolerant actinomycetes can be cultured on 0-15% NaCl, except those halophilic actinomycetes which need more 2-20% NaCl. Based on the 16S rDNA sequence analysis, these strains belonged to *Actinopolyspora*, *Nocardiopsis*, *Saccharomonospora*, *Saccharopolyspora*, and *Streptomyces*. Identification and phylogenetic relationship of the rare 19 actinomycetes strains (non *Streptomyces*) were studied. According to the phenotypic and genotypic data, one novel strain of *Nocardiopsis* was proposed as a new record species. The others of *Nocardiopsis* were identified to *N. synnemataformans*, *N. dassonvillei*, *N. prasina*, and *N. compostus*, respectively. Three of the nine *Saccharomonospora* strains were identified as *S. azurea*, the other six strains can not be identified as valid species. The halophilic and thermophilic-halotolerant strains were identified as *Actinopolyspora iraqiensis* and *Saccharopolyspora rectivigula*, respectively.

2. Fungal Resources

(1) Osmotolerant yeasts in Taiwan

Thirty-two isolates collected from mangrove plants, surroundings, estuary

environment or sea animals were analyzed on the basis of 26S rRNA gene D1/D2 region sequencing. Results showed that these isolates were quite diverse in phylogeny. Isolate 07Y0062 was identified as *Cystofilobacidium bisporidii*, which is a new record species in Taiwan. According to the phylogenetic trees, some isolates could be novel yeasts but need to be determined in further study.

(2) *Meira* and related genera in Taiwan

Meira and related genera (*Acaromyces* and *Sympodiomyces*) have potential application on food industry, agriculture, environment and medicine. The importance of their correct systematics has increased in recent years. *Meira* genera are polymorphological, and are rare yeast-like fungi. There were only few strains preserved in BCRC and the collection of the native *Meira* strains appears to be important in order to provide more resources for further screening and product development.

Thirty-six local strains were collected and preserved. Based on the ITS1-5.8S-ITS2 region sequences, these strains fell into nine clades. In the genera *Meira*, *Acaromyces* and *Sympodiomyces*, six species were recognized in the world. Phylogenetic analysis revealed that there were more than nine species in Taiwan. This study showed the diverse biodiversity of local strains within genera *Meira*, *Acaromyces* and *Sympodiomyces*. To study the systematics of local *Meira* and related fungi, DNA-DNA hybridization, morphological and physiological characteristics were performed.

(3) The establishment of osmophilic fungal resources bank in Eurotiales

Eurotiales, an order of fungi in the phylum Ascomycota, was characterized by the presence of well defined cleistothecia. The anamorphic stages play important roles in industry and medicine. Strains in 84 samples, including soils, teas, Pu're teas, Chinese herbs, dried shrimps, dried salt fish, maple syrup, Katsuobushi and a variety of dried seeds, were isolated by DG-18 medium. Four hundreds and forty-one osmophilic strains were isolated and preliminarily classified by stereo-microscopy. Most isolates belonged to *Eurotium* (up to 223 isolates). Eighty nine isolates were *Penicillium* and 58 isolates were *Aspergillus* with the rest of isolates belonging to *Paecilomyces*、*Monascus*、*Trichoderma*、*Wallemia sebi* and other genera. Partial β -tubulin genes of 181 *Eurotium* isolates were sequenced and compared with the sequences of their type strains. Eight species were identified, including *E. repens*, *E. rubrum*, *E. herbariorum*, *E. chevalieri*, *E. amstelodami*, *E. tonophilum*, *E. niveoglaucum*, and *E. echinulatum*. Among them, *E. tonophilum*, *E. echinulatum*, and *E. niveoglaucum* were newly recorded in Taiwan.

The morphology of the selected isolates and type strains of *Eurotium* species were examined by LM and SEM. Results showed that the surface ornamentations of conidia and ascospores, under SEM observation, were reliable characters in the delimitation of species (Fig. 1). The ITS and partial β -tubulin gene of *Eurotium* isolates and type strains were sequenced and analyzed. The analysis results showed that the sequences of partial β -tubulin genes provided better differentiability than ITS

sequences in the phylogenetic study of *Eurotium*. In cultural study, test strains were incubated in the medium with water activity (a_w) between 0.995 and 0.65. Most species grew slowly when a_w was below 0.80, but some species could grow on extremely low a_w condition at 0.75.

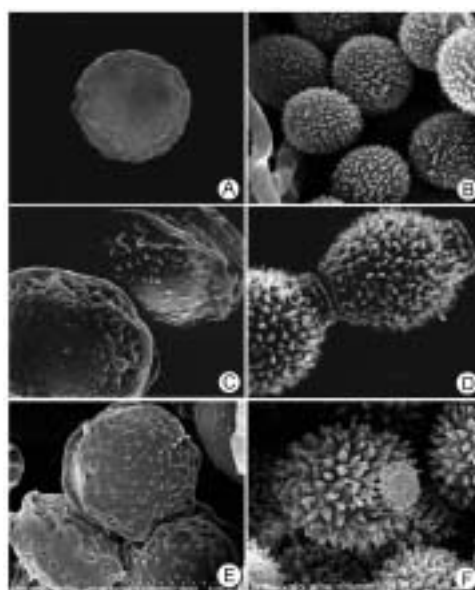


Fig. 1 SEM micrographs of *Eurotium* spp. Top, *E. tonophilum* ascospore (A) and conidia (B); middle, *E. echinulatum* ascospores (C) and conidia (D); bottom, *E. niveoglaucum* ascospores (E) and conidia (F)

(4) The development of *Termitomyces* and the fungal strains collected from the nests of termites.

Termitomyces is a kind of special mushroom, which is symbiosis with termites. The fruiting bodies of *Termitomyces* sp. grown up from the nest of the termite, *Odontotermes formosanus*, were observed in the field (Fig. 2). The development of asexual and sexual stage of *Termitomyces* sp. including initiation, development and maturation of the conidial stage, and sexual fruiting body on nest were

studied by stereo, light and scanning electron microscopy. Twenty strains of *Termitomyces* were collected from the fruiting body of *Termitomyces*, nest of termites, and alimentary canal of workers from the community in this study. Those strains were then deposited in BCRC for further study.

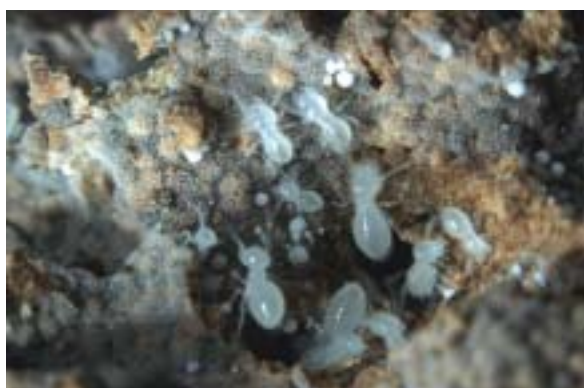


Fig. 2 The fruiting bodies of *Termitomyces* grew from the nest of termites

3. Genetic Resources

(1) Collection and preservation of genetic resources

We have built the preservative system of genomic DNA to extend the service of genetic resources. Genomic DNA from 20 type strains of lactic bacteria has been persevered. In addition, five fosmid libraries from two actinomycetes, two marine bacteria, and one lactic acid bacterium were collected and

preserved. Totally, 33,700 clones were preserved.

(2) Genetic resources of lipases

Lipase producing strains were screened from marine bacteria, thermophilic actinomycetes, or soil microorganisms. Shotgun libraries from above strains were constructed and the lipase-producing clones were screened. Ten selected lipase genes were sequenced and blasted. The amino acid sequences deduced from the nucleotide sequences of these genes displayed 50~82% identity with the published lipases. Furthermore, the lipase genes were cloned into the expression vectors of *E. coli*. Highly expressed proteins were purified and the lipase activities were assayed.

4. Cell Resources

(1) Collection and preservation of cell lines established in Taiwan

National Health Research Institute (NHRI) supports FIRDI to cooperate the cell bank core facility project to establish national cell bank, which has collected and preserved cell lines for academic researches since 1998. This year, BCRC cooperated with local researchers to preserve some particular diseases' cell lines of Taiwan to provide multiple sources of cell lines. These cell lines can be applied in clinical and biochemical researches, development of preventive medicine, and application of basic medical researches. FIRDI already signed a contract with Dr. Kwang-Jen Hsiao of Taipei Veteran General Hospital to collect inherited metabolic disorders' lymphoblast and fibroblast under a

special collection project. Some of the cell lines have been preserved and are available for distribution to research communities.

(2) Cryopreservation technique of *ex vivo*-expanded limbal stem cells was awarded by Troutman Cornea Prize

The team led by Dr. Shiaw-Min Hwang in BCRC had successfully developed techniques to expand and cryopreserve the limbal stem cells, which was published in *Cornea* (Cornea 2008; 27:327-333: Cryopreservation of Human Limbal Stem Cell *Ex Vivo* Expanded on Amniotic Membrane). Prior to the study, these cells were dumped in the medical waste after cornea transplantation. Stem cells can self-renew and differentiate into different cell types. This work is thus recognized as beneficial to patients who need limbal stem cell transplantation in the future. The researchers participated in this work were Hui-Jung Yeh, Chao-Ling Yao, Hsin-I Chen, Huey-Chuan Cheng, and Shiaw-Min Hwang. The first author, Ms. Hui-Jung Yeh, was invited by The Cornea Society/EBAA (Eye Bank Association of American) 2008 Fall Education Symposium and AAO (American Academy of Ophthalmology) to present this work. She received the Troutman Cornea Prize and an award of US\$ 5,000 (Fig. 3).

II. Systematic Bioresource Management and Service

1. TAF accreditation and ISO 9001

BCRC is a TAF-accredited test laboratory. We comply with the International Standard ISO/IEC 17025:2005 and are able to carry out many tests, including five bioassays for



Fig. 3 Ms. Yeh (middle) was awarded 2008 Troutman Cornea Prize by the Cornea Society. Dr. R. C. Troutman (left) and the chairman of the Cornea Society, Dr. M. J. Mannis

detecting mutagenic compounds (Ames test) and three anti-microbial tests (JIS Z 2801). This year we have received a new accreditation item for the detection of *Legionella* spp. on December 9, 2008 (Fig. 4). We also maintain the international quality system ISO 9001 after on-site assessment by AFAQ-AFNOR on December 12, 2008 (Fig. 5).

2. Innovation and service-oriented information system

To fulfill the requests from the customers through the Internet, the information service of BCRC is designed towards internationalization, system and diversity. The innovative structures of the new website service contain three systems: one is the e-commerce for distribution of bioresources; the other is the google-like search engine; and the last is the



Fig. 4 Certificate of ISO/IEC 17025:2005 by TAF



Fig. 5 Certificate of ISO 9001:2000



Fig. 6 Service-oriented webpage of BCRC

subscription of online-newspaper. The new service made a two-fold increase in number of browsers and a 10% increase in revenue (Fig. 6).

3. Fungal knowledgebase in Taiwan

The information of a total of 1,153 fungal strains isolated from Taiwan has been included in the database of Taiwan Fungal Flora

Knowledge (Fig. 7). In order to give comprehensive review, a webpage was designed to have three browsing viewers, including the tree-view, alphabet-view, and map-view, on the website of <http://www.bcrc.firdi.org.tw/fungi/r.jsp>. Up to date, there have been at least 122,440 visitors visiting the website since the opening of the database in June, 2008.

4. BCRC services

(1) Collection of bioresources

BCRC keeps extending the diversity of its collection. In 2008, 292 newly collected strains (including 13 genera and 119 species) and five gene banks were preserved. The new collections were mainly deposited from local researchers. Most deposits were fungi with 110

strains preserved, followed by bacteria. Additionally, a special collection of 2,440 strains including bacteria, yeasts, mushrooms, and fungi isolated from specific environments, i.e. ocean, forest soil, fermented foods, etc. was established. All strains have been well persevered to expand the current collection. As of December 2008, BCRC has held over 20,000 strains of microbial resources (Fig. 8).

(2) Culture distribution and services

Of the 5,095 batches of culture distributed, bacteria accounted for the major portion of the sales, followed by cell lines, fungi, and yeasts (Fig. 9). Nine hundred and forty-seven contracted tests were performed in 2008. Of these, 69% (559 cases) were conducted for industries (Fig. 10). Most tests examined the inhibition of bacteria on



Fig. 7 The figures and descriptions of morphology of fungus were displayed one by one according to the search for fungus isolated from Taiwan

household fabrics or materials and examined the types and quantities of microorganisms in commercial products. Other tests analyzed the ingredients (monacolin K, citrinin, γ -aminobutyric acid, etc.) of *Monascus* products. Besides, services of cultivation of microorganisms and cell lines were also provided. Additionally, 138 contracted identification of 177 microbial isolates were consigned by industries (62%), institutes (22%), or universities (16%) (Fig. 11).

(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: 2000 quality management system has been adopted for this deposit services since the year of 2000. Up to the end of 2008, a total of 1,597 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 storeroom are operated under strict managerial regulations. In addition, the patented biological materials were offered for research purposes upon request after the patent was issued. Consultation is

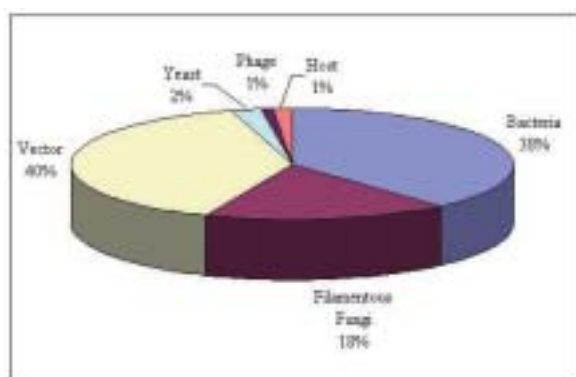


Fig. 8 Culture collection in 2008

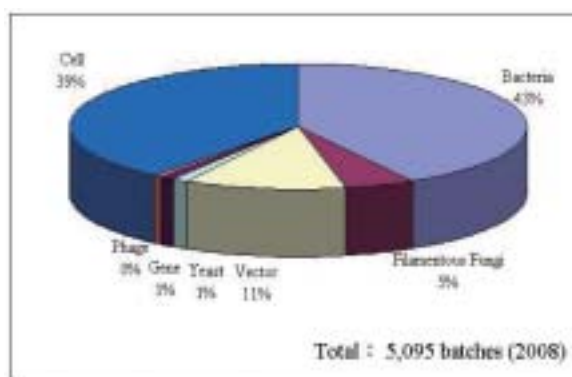


Fig. 9 Bioresources distribution in 2008

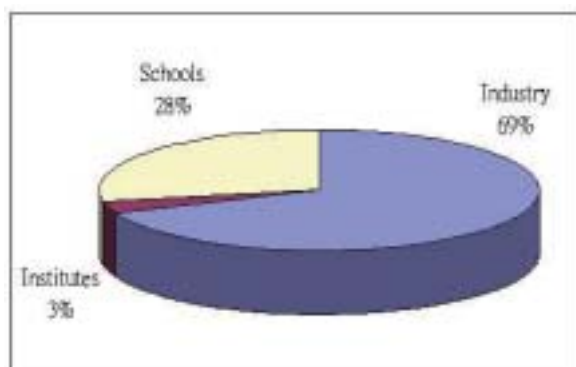


Fig. 10 Contracted tests performed in 2008

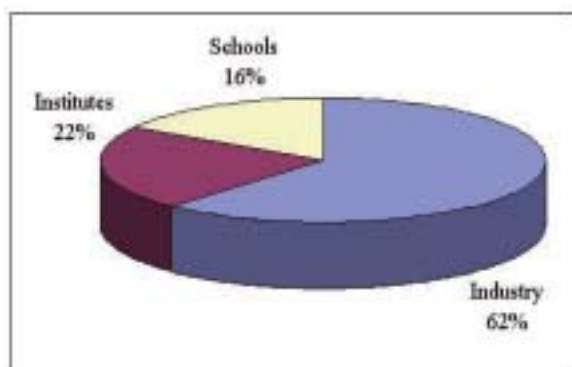


Fig. 11 Strain identification performed in 2008

provided as necessary to time by FIRDI through various pathways.

Table 1. Types of deposited biological materials for patent purposes (as of the end of 2008)

| Type of biological material | Percentage |
|-----------------------------|------------|
| Bacteria | 26 |
| Yeasts | 4 |
| Filamentous fungi | 7 |
| Plasmids | 35 |
| Hosts | — |
| Cell lines | 24 |
| Viruses and phages | 3 |
| Others | 1 |
| Total | 100 |

III. Innovative Value-Addition and Application of Bioresources

1. Serum-free induction of chondrocytes from mesenchymal stem cells

Mesenchymal stem cells (MSCs) are responsible for cell proliferation and differentiation in the mesodermal layers. They often exist in bone marrow, fat, cord blood, placenta, or amniotic fluid. Human MSCs can give rise to several mesenchymal lineages,

such as chondrocytes, adipocytes, and osteoblasts. Therefore, MSCs have a great potential and application in the tissue engineering and clinical cell therapy. *Ex vivo* induction of chondrocytes from autologous or allogeneic MSCs and then implantation of them into lesions and degenerate region may provide a novel therapy for cartilage repair. However, chondrocyte transplantation in patients has been limited by the insufficient numbers of MSCs or chondrocytes to efficiently reconstitute cartilage function. In previous study, we has developed a serum-free MSC expansion medium (SF-MSC) and MSCs can be expanded intensively in the serum-free condition. In this study, we further developed a serum-free induction medium for large generation of chondrocytes from MSCs with seven factors. The results also indicated that induced chondrocytes derived from serum-free expanded MSCs exhibited both characteristics and functions of chondrocytes. Therefore, *ex vivo* expanded MSCs can be induced into chondrocytes efficiently and provides a promising cell source for cell therapeutic approaches in the future (Fig. 12).



Fig. 12 Chondrocyte induction from mesenchymal stem cells by pellet culture
Morphology after 3-week induction (left panel) and Safranin O staining (right)

2. Serum-free induction of megakaryocytes from hematopoietic stem cells

Hematopoietic stem cells (HSCs) are defined as cells derived from blood or bone marrow with both the capacity to self-renew and the ability to differentiate into at least eight distinct hematopoietic cell lineages. HSCs can serve as a transplantation source for a variety of malignant and nonmalignant hematologic diseases and myelopoietic support to patients who are undergoing high dose chemotherapy. We have developed a serum-free and stroma-free (SF-HSC) culture system for expanding HSCs. Based on the expansion system, we further developed serum-free induction systems to induce expanded HSCs into functional megakaryocytes. Results showed that the average absolute fold expansion for megakaryocytes was over 4,000 within 2 weeks. Importantly, transplantation of serum-free induced megakaryocytes could accelerate the platelet recovery in NOD/SCID mice. Our method may represent a promising source of megakaryocytes and platelets for future cell therapy.

3. Discovering estrogen and thyroid hormone modulators from biological resources

To discover potential drug leads from natural products and compounds collected in BCRC, we have developed several target-based screening assays. These assays enable high-throughput identification of molecules that modulate specific nuclear hormone receptors. Two reporter systems were established in 2008 to monitor the level of activation of estrogen receptor and thyroid hormone receptors. Luminescent reporter genes such as alkaline

phosphatase gene or luciferase gene were used to monitor the activities of nuclear hormone receptors. The assay systems for glucocorticoid receptors, androgen receptors, estrogen receptors, and progesterone receptors have been established during previous years. All assays were conducted in microplates and samples could be analyzed in any forms of pure compounds, fermentation broths, or crude extracts in the system. In addition to analyzing microbial samples from BCRC, we also offer screening services to researchers and industries that are interested in above biological activities.

4. Fermentation bank of fungi isolated from polluted-water

There were only few studies on aquatic fungi compared to studies on the terrestrial habitats in the past years. In this project, about 100 strains of aquatic fungi, isolated from polluted stream or sewage in Taiwan, were cultivated in submerged and/or solid fermentation media to establish fermentation bank of broths and extracts. Activity assays showed that some samples of the bank could inhibit the growth of human tumor cells, microbes, and/or tyrosinase activity. The fermentation bank may have great potential on pharmaceutical industry.

5. Screening of fucose-producing microorganisms

Fucose is a deoxy hexose with great potential to be a new group of diet supplement for human health. Fucose plays a very important role in the recognitions of cell-to-cell communication. Insufficient fucose will cause

immune system disorders. Fucose also shows the ability in activating the brain cells and inhibiting the growth of breast or other tumors. Traditionally, fucose is extracted by a tedious and time-consuming process from huge seaweeds such as red or brown seaweeds. The objective of this project was to develop a new process for fucose production using lactic acid bacteria or other microorganisms. One potential fucose production strain was obtained by screening 355 bacterial isolates and 32 edible mushroom strains. The yield of fucose was over 0.5 g/L as determined by GC-MS.

6. Development of exopolysaccharide-producing lactic acid bacteria

In this study, the characteristics and functionality of exopolysaccharide (EPS) - producing lactic acid bacteria (LAB) and the EPS were investigated. The EPS-producer, isolated from a traditional fermented food, was tolerant to acid, bile salt, and sodium chloride. The productivity of EPS was successfully improved in the 5-L fermentor. Not only very high yield was obtained but also the EPS activity for induction of peripheral blood mononuclear cells (PBMC) to produce IFN- γ and IL-12 was enhanced. Furthermore, we established an appropriate cultivation technique for high amount of EPS juice fermentation by the EPS-producer. The flavor of the fermented juice was highly acceptable.

7. Development of lactic acid bacteria with immunomodulatory activities from the bank of probiotics

The studies on functionality of lactic acid bacteria (LAB) are expanding in the past years.

The application of LAB is not only to enhance the gastrointestinal function but also to improve the immunomodulatory activity. In this project, more than 100 LAB strains were selected from BCRC. We used cell line and/or peripheral blood mononuclear cells (PBMC) to investigate the ability of stimulating the activity of macrophage cells and PBMC. Strains with potential to induce the immune system toward Th1 reaction were obtained. According to the results of germ free mice experiments, no pathological inflammation was found and the immature immune system was back to normal state. Therefore, the strains were recognized as safe and possessed functionality in immunomodulation.

8. Development of potential carnitine-producing strains

Carnitine, a new functional food additive, is widely used in foods, drinks, and health protection foods to strengthen the nutrition value for infants or elders, increase the stamina of athletes, and also enhance the weight losing for the obese people. With unique stability and safety, carnitine has been prosperously applied in various fields. There only a few countries produce carnitine. Taiwan depends solely on import for its supply of carnitine. Therefore, a project to develop potential carnitine-producing strains was carried out. Carnitine-producing strains were improved by series mutations, stability analysis, and finally combined with the most suitable medium in a 5-liter fermentor to increase production. Moreover, we explored the scavenging ability for free radicals of carnitine products. We will focus mainly on the technology of carnitine



Fig. 13 Bacterial cellulose. Left, bacterial cellulose with a cylindrical geometry; middle, cylindrical shape of bacterial cellulose after drying; right, bacterial cellulose designed for sausage peeling

production and carnitine purification in the future to satisfy the requirements of the industry, especially in the application of losing weight.

9. Research and development of microbial cellulose

Bacterial cellulose, a natural cellulose from *Gluconacetobacter xylinus*, is the thinnest fiber known with a diameter of 30-50 nm. With no lignin and hemicellulose, the purity of bacterial cellulose is higher than those of normal plant fibers, resulting in good mechanical properties in uniformity, thermal insolubility, high tensile strength, high moisture absorption, and shape protection. Traditionally, bacterial cellulose is produced in static-culture. The process is labor intensive and time-consuming with the production of highly crystallized cellulose, making further fabrication difficult. In order to apply bacterial cellulose on casings for food, we have designed an efficient production process in which *G. xylinus* could produce cellulose with particular geometry (Fig. 13). The cellulose can be used in casings and biomedical dressings. The process had a higher production titer than that of traditional one.



Fig. 14 Preparative sample of blueberry juice containing metallothionein

10. Development of metallothionein-producing *Saccharomyces cerevisiae*

Baker's yeast, *Saccharomyces cerevisiae*, was selected from preserved strains in BCRC, and a potential mutant with higher production ability of metallothionein was obtained through NTG mutations. In a 5-liter fermentor, the effect of cell density and various operation parameters for improving the metallothionein production was examined and explored. Results showed that the microbial density and the yield of metallothionein were increased significantly. Moreover, an ultrafiltration membrane system was used to purify metallothionein and a juice containing metallothionein was prepared for testing (Fig. 14).

IV. 2008 International Symposium on *Monascus*

BCRC was privileged to be the host of the 2008 International Symposium on *Monascus* (*Monascus* 2008). The symposium was held in the Assembly Hall, CCMS & Physics Building, National Taiwan University, Taipei, Taiwan on Dec. 16-17, 2008. The meeting served not only as a platform for *Monascus* researchers to come together and share their knowledge and research findings but also an event to promote all aspects of *Monascus* application. The theme of this meeting was "Promote Innovation and Value-addition on *Monascus*". *Monascus* is a traditional strain used in fermentation food in Asia. More than 200 participants from Thailand, Korea, China, and Taiwan attended the conference (Fig. 15). A total of 15 oral presentations and 40 posters were contributed. The discussion panels contained chemical analysis of metabolites, fermentation technology, new application in food and

beverage industries, clinical analysis, and genetic and molecular biology of *Monascus*.

V. The Guidance Document for the Safety Assessment of Genetically Modified Foods

The project has drafted three guidelines for the safety assessments of genetically modified (GM) food: (1) 「Guideline for Food Safety Assessment of Foods Derived from GM Animals」, (2) 「Food Safety Assessment in Situations of Low-Level Presence of Recombinant-DNA Plant Material in Food」, and (3) 「Guideline for Food Safety Assessment of Foods Derived from Plants with Stacked Traits」. The draft guidelines will assist the government authorities in regulating food safety assessment of foods derived from GM animals, GM stack events, and dealing with situations of low-level presence of GM materials in food.



Fig. 15 Invitees and specialists of '*Monascus* 2008'.

Analysis Research and Service Center



Counterfeiting is a major problem in the global food and drink industry. Last year, the melamine-tainted milk products made in China have rocked the global food market. The crisis started with contaminated milk powder in infant formula but has spread to milk-based processed foods shipped to Taiwan and many other countries. As the first food inspection institute certified by the government, we started the test of the contaminant of melamine in food for domestic food producers. Among 2,785 of food samples, there were 11 products found to have melamine at levels mostly below 10 parts per million. This year the laboratories of microbiology have joined the oversea proficiency tests held by UK Central Science Laboratory for molds, yeast and lactic acid bacteria. The organization gave our labs the evaluation of excellent performance with Z value < 1 .

As for the research projects, we continued the work on the promotion of quality assurance systems. Studies on the food quality control and food-processing technology were also carried out. The quality of our service to the industry is progressively improved based on the application of these technologies. The major projects conducted in 2008 are as follows.



Analysis Research and Service Center

I. Promotion of Quality Assurance System

1. The promotion of CAS food system

The CAS quality food system is sponsored by the Council of Agriculture and has been promoted by FIRDI for 21 years. As of the end of 2008, 170 food manufacturers of 3,145 food products were approved as users of the CAS mark. The products produced by these manufacturers included 617 frozen food products, 1,800 ready-to-eat products, 101 chilled food products, 9 fresh mushroom products, 95 fresh-cut vegetables, 18 juice products, 67 preserved food products, 121 fermented food products, 136 refreshments, 44 rice products and 181 seafood products. To improve the CAS system, four research projects involving quality control and process improvement were also completed.



Fig. 1 Vacuum packaging of CAS dried mullet roe

Table 1. Promotion of CAS food system in 2008

| Items | Manufacturers | | Products | | Product inspection | |
|-------------------|---------------|-------|----------|-------|--------------------|--------|
| | new | total | new | total | Factory | Market |
| Frozen foods | 3 | 45 | 35 | 617 | 133 | 193 |
| Juice | 0 | 5 | 1 | 18 | 12 | 17 |
| Pickles | 1 | 8 | 3 | 67 | 33 | 30 |
| Ready to eat meal | 1 | 23 | 5 | 1,800 | 81 | 32 |
| Chilled food | 1 | 9 | 6 | 101 | 26 | 20 |
| Fresh mushroom | 0 | 2 | 0 | 9 | 6 | 9 |
| Fermented food | 0 | 5 | 11 | 121 | 16 | 27 |
| Refreshments | 1 | 16 | 6 | 136 | 48 | 34 |
| Fresh cuts | 5 | 23 | 16 | 95 | 81 | 11 |
| Sea food | 6 | 34 | 21 | 181 | 87 | 43 |
| Total | 18 | 170 | 104 | 3,145 | 523 | 416 |

(1) Seafood

Five new plants and production lines were approved as users of the CAS mark during the fourth year, including Jeng-Shin Seafood Manufacture Ltd., King-Car Biotechnology Industry Co. LTD., Jaan-Sheng Foods Co. LTD.、Eagle Cold Storage Enterprise Co. LTD. and Fortune Life Enterprise Co. LTD. At the end of 2008, there were 34 CAS-certified fishery plants producing a total of 181 processed products, and 96 times of follow-up inspections of these plants had been completed.

Furthermore, 87 plant products, 43 market products and 21 newly certified products underwent quality inspection. Three products of fried sailfish shreds were found not to comply with the CAS regulation, among which, two had an excess peroxide value (POV) and one had excessive starch content. The producers of these products were immediately informed and follow-up inspections were organized until these producers were found compliant. Residue analysis of eight kinds of antibiotics for all 16 fresh seafood samples was found to comply with the CAS regulation.

(2) Fresh shrimp

In 2008, the quality and hygiene regulations for high-quality fresh shrimp were established. There are eight items of regulations on hygiene, including (1) factory environment, (2) factory hardware arrangement, (3) mechanical facilities, (4) process management, (5) quality control, (6) hygiene management, (7) warehouse and transportation management, and (8) others. The quality regulations include (1) quality criteria, (2)

certification mark and (3) examination items, methods, and standards for high-quality fresh shrimp.

(3) Rice products

In 2008, 18 factories with a total of 44 rice products were approved to use the CAS mark. About 154 samples were inspected for their chemical hazard, including pesticides residues, heavy metals and aflatoxins. The results showed that all samples tested were satisfied with CAS regulation.

2. Implementation of the food safety control system in boxed lunch plants and foodservice establishments

In 2008, totally 276 food plants including 204 boxed-lunch plants and 72 food service establishments were certified to use the HACCP logo approved by the Department of Health. Fifty-eight (58) times of follow-up inspections were conducted for all certified plants. The most common defect found was poor sanitation that accounted for 55% of the total defects. This year, there are three discussion meetings for the HACCP auditors, three sessions of announcements for the transfer of HACCP certification and one practice symposium. The relationship between implementation of HACCP by plants and their rates of food poisoning in the past two years have been evaluated and data collected for statistics study.

3. Promotion of nutrition labeling of domestic packaged food products

To continue this project, the following work was undertaken this year.

1. Six announcement meetings for nutritional

labeling system were held for manufacturers.

2. Two consensus meetings were held for the officers of local Health Bureau.
3. To evaluate the nutritional labeling of 7 basic nutrients and their analytical methods as well as the tolerance deviation;
4. To get more information on the definition of nutrients and evaluate the possibility for the labeling of new items such as dietary fibers 、 calcium and sugars.

4. Application of food composition database and development of analytical methods

In 2008, the contents of food composition database were expanded and revised. Sixty items of food were analyzed for proximate composition, minerals, vitamins, amino acids, fatty acids, cholesterol, dietary fiber and sugars. The newly established database contains 5 cereals, 1 vegetables, 4 seaweeds, 7 mushrooms, 9 soybean products, 15 meat products, 11 shellfish products, 2 egg products, 2 dairy products, 1 beverage, 1 frozen prepared product and 2 condiments/seasoning products. Four books that contain the database of fruits, vegetables, seaweeds, mushroom and soybean products were published this year. There were 36 samples of 9 different kinds of beverages purchased from 4 chain stores used for proximate composition and sugar analysis.

5. Evaluation of nutrient analysis method for infant formula and follow-up formula

Methodologies on the analysis of 5 major nutrients including vitamin C, vitamin B₁, choline, calcium and phosphorus were collected and evaluated. The summarized information and analytical data were fully

discussed by committee meetings. Finally, a total of nine 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.

6. 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 posed to public health. In 2008, reports on 80 chemical/ microbial hazards of food were completed, including 50 pesticides, 10 veterinary drugs, 9 pathogenic bacteria and 3 biotoxins, 4 food additives and 4 environmental hormones. Both professional and general versions of the database exist.

7. Studies on the analytical methods of heavy metals in cosmetics and their application

The main purpose of this project is to assist Department of Health to strengthen the management of cosmetic safety. In 2008, international official methods and related research papers for determining heavy metals were collected and evaluated. Database was established and organized in terms of sample categories and analytical methods. The analytical methods of 9 heavy metals including lead, mercury, arsenic, cadmium, chromium, selenium, strontium, zirconium and cobalt in cosmetics were revised. The precision, accuracy, sensitivity, detection limit and sample interference of these methods were also studied. By these evaluations, the feasible

analysis methods were suggested for further promotion as a monitoring platform for heavy metals in cosmetics. Moreover, the safety evaluation on 9 heavy metals in cosmetics was also studied in this work.

8. Drafts for CNS coffee standards

Coffee consumption has been growing rapidly these years in Taiwan. As a member of WTO, it is important to revise and update the domestic quality standard of coffee. In 2008, the following work was undertaken.

1. The difference between the current CNS coffee standards and other international standards was compared and reconciled.
2. Five committee meetings and one announcement meeting were held.
3. Analytical methods of moisture content for two kinds of roasted ground coffee and two kinds of green coffee beans were evaluated.
4. One survey report on coffee related industry was accomplished.
5. Drafts of Twenty-two coffee CNS national standards and analysis methods were established both in Chinese and English version.

II. Technology Development

1. Quality evaluation of fresh grape juices

The quality of freshly squeezed juices from the local grapes was compared with the imported grape juice.

The results indicate that the content of anthocyanin malvidin 3, 5 - diglucoside can be used as an indicator to differentiate Taiwan Kyoho and Black Queen varieties from Italian Syrah and Merlot grape varieties. The level of Malvidin 3 - O - glucoside chloride can be used

as an indicator to differentiate Taiwan Black Queen from American Concord. The total content of peonidin 3 - glucoside chloride and malvidin 3 - O - glucoside chloride can be used to differentiate domestic Black Queen from Kyoho grape. The volatile compound of 1-hexanol of fresh juice increased while anthocyanin content decreased during storage. Therefore these can be used to identify the fresh squeezed juice from blanched juice. The ratio of free amino acid of alanine, γ -aminobutyric acid and arginine to proline can be used to differentiate the domestic fresh grape juices from the imported juices.

2. Quantitation of animal material in frozen food by real-time PCR

The *cdk4* gene in pork and ITS1 gene in shrimp were designed for primers and probes to detect pork and shrimp content in frozen foods. They were used to examine 15 kinds of pure animal material simultaneously by real-time PCR. There were no false positive results and with good specificity. The quantitation curves of dumplings and shrimp balls which contained 1, 4, 16 or 64 % pork or shrimp were linear with a R^2 of 0.99 and 0.98, respectively. By using these specific primers and probes, the pork content of three kinds of marketed dumplings was measured. The data obtained was 3 % to 6 % lower than the real amount. The shrimp content of shrimp balls measured was about 2 % to 3 % lower than the real level.

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

The *S1*, *invA*, *hbl* and *tlhA* gene were designed respectively as a multiplex PCR

primers and probes for detection of *Staphylococcus aureus*, *Salmonella* spp., *Bacillus cereus* and *Vibrio parahaemolyticus*. They were used to detect the four pathogens in single or mixed cultures simultaneously by multiplex real-time PCR. There were no false positive results and with good specificity. The quantitation curves of these pathogens detected by this method were linear with a R^2 of 0.98. The simultaneous detection limit was 10^3 CFU/ml for *Bacillus cereus* and 10^2 CFU/ml for the other three pathogens by multiplex real-time PCR.

4. Prevention of enzymatic browning of fresh cut vegetables

There was no difference between enzymatic browning of fresh cut lettuce and cabbage prepared from raw material immediately after harvest or that have been stored for one month at low temperature. Manual or mechanical cutting had no effect on browning of fresh cut during cold storage. Enzymatic browning of fresh cut progressed fast at storage condition of high humidity and high temperature. It will be helpful to apply anti-browning reagent to prevent browning of certain vegetables. For fresh cut cabbage, cysteine or calcium propionate treatment revealed the best anti-browning effect with a shelf life of 12 days. Immersion of lettuce cut in the solution of 0.5 % citric acid + 0.05 % cysteine or 0.05 % β -cyclodextrin could extend the shelf life to 10-14 days. Fresh cut potatoes rinsed with solution of 0.05 % ascorbic acid + 0.05 % cysteine at pH 3.54-3.68, were followed by vacuum packaging without removal of excessive water and storage at 4°C. These

processes not only prevented the enzymatic browning of fresh cuts but also extended their shelf life to 14 days at low temperature.

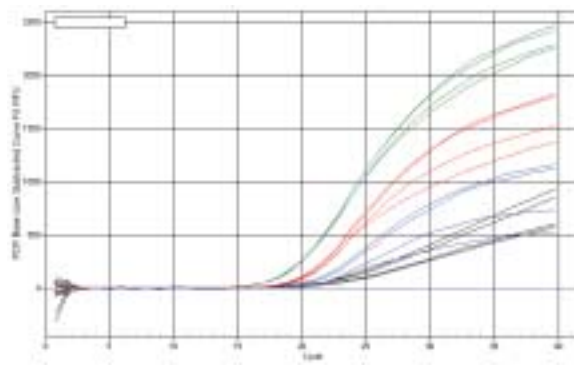


Fig. 2 Simultaneous detection of *Staphylococcus aureus*, *Salmonella enterica* subsp. *enterica*, *Bacillus cereus* and *Vibrio parahaemolyticus* by multiplex PCR. *Staphylococcus aureus* BCRC 12656 (black) *Salmonella enterica* subsp. *enterica* BCRC 12 (green). *Bacillus cereus* BCRC 10603 (blue). *Vibrio parahaemolyticus* BCRC 12877 (red). All four pathogens were about 10^6 CFU/ml



Fig. 3 Fresh cut potatoes treated with 0.05 % ascorbic +0.05% cysteine, followed by vacuum packaging and storage at 4°C (2-2) have a shelf life of 14 days

Technical Service and Extension Center



Technical Service and Extension Center plays as the contact window and as the linking bridge between the Institute and industry to provide various technical services. The service scope is designed to meet the need of food industry in terms of technology advance and regulation changes. All these service items are listed in the current "Technical Service Manual", which includes manufacture problem-consulting, chemical analysis, microbiological examination, pilot scale processing, consulting of quality improvement systems. Besides, considerable efforts are devoted to carry out the related policies of the government agencies, such as registration of canning establishments for domestic and USFDA, implementations of different programs, such as GMP, CAS, HACCP, GHP, Good wine, food traceability and professional technical training. All of these aim at helping food industry to create better working environment with higher level technologies and well qualified personnel, so as to increase the competitiveness of food industry.



Technical Service and Extension Center

I. Promotion of GMP Program

In 2008, thirty four factories applied for Food GMP certification, among these 12 factories were qualified to further on-site inspection, and 32 factories passed, ending up a total of 523 granted factories. After mergence and withdrawn of 187 factories, the granted factories are 336 factories so far. One hundred and forty eight products from the 32 new granted factories were approved to use the GMP logo this year, ending up 3,147 item granted. Follow up inspections have been conducted for the 336 granted factories. There were 883 rounds factory inspection performed and 1,597 product items sampled and examined. Results on follow up inspection showed that 48 factories are in excellent status, 180 in good status and 101 in general status, while 7 factories required additional instructions. Upon the safety and quality, all the 1,596 products passed the examination. In the

aspects of information and diagnosis, 200 queries about food GMP system were received from food companies. Upon the consultation requested from 24 factories applying for the GMP certification, 24 reports about diagnosis and instruction were provided to the related companies for reference.

One technical report entitled "Development and Application on Deep Sea Water in processing products" was issued and a conference about this Topic was held in FIRDI on October 15 with 62 participants. For industrial promotion, 3 GMP management conferences were held on Nov. 18, 19 and 20 in Hsinchu, ChangHwa and Kaoshung with participants of 73, 81 and 79 respectively. In 2008, a specific food GMP guideline about functional food was established. In addition, 4 functional food quality specifications were also set up.



Fig. 1 The working group of this center

II. Establishment of Food Company Auditing Manual

In 2008, auditing manuals for canned foods 、dehydrated foods 、soy sauce 、fined sugar and saccharified sugar companies were established, and a related conference was also held.

III. Certification for Liquor Products

After termination of monopolization , to ensure the quality of the alcoholic products in market, a certification system, Fancy Liquor Logo, has been established by National Treasury Agency since 2004. In 2008, the fifth year, 2 fruit wine, 1 rice wine and 1 grape wine manufacturers were granted to use "Fancy Liquor" logo and a total number of certified liquor manufacturers reached 25 with 144 certified products including sorghum liquor, rice wine, fruit wine and grape wine. To maintain the authority of the certification system, there were 75 follow up audits performed, 384 product items sampled and examined, 76 consultations conducted, 24 technical services provided, and 4 conferences help in 2008. A script of certification standard for refined fruit wine was established this year to extend the scope of certification.

IV. Project on Food Safety Management System

Adequate commercial sterilization in process is the key point to ensure the safety of canned foods. The project aimed at establishment of thermal process, auditing, and market surveillance. In 2008, management systems of 85 canned food manufacturers were investigated. In addition, process information



Fig. 2 Round table discussion on GMP audit quality



Fig. 3 A glance at Fancy Liquor producing

of 41 PET-packed hot-filled products was collected. Conductions of heat distribution test and heat penetration test conducted were 39 and 686 respectively. Besides, 164 market monitoring reports on product sterilization were issued, and 1,304 canned food samples were tests for their quality. A conference was also held in December 2008 in the hope to highlight the importance of the risk control for canned foods.

V. Program on Taiwan Food Traceability System

Recently, several countries focus their Food Safety Measurement on identification of

potential unsafe products. Under such trend, a project, Establishment of Taiwan Food Traceability System (TFTS), sponsored by DOH has been carried out by FIRDI since 2007. Consumers can access the traceability information , including those of raw material, process and end product that was uploaded by local factories at the TFTS website (tfts.firdi.org.tw). During 2008, eleven packaged water products of three factories were appended into the system. The processing flowchart of any products can be arranged flexibly and then showed on the website. Questionnaire survey about the traceability system of packaged water products, nonalcoholic beverage products and dairy products was conducted. Results from the survey were given to DOH for controlling over food safety of local products. A checklist for milk product was also prepared for the implementation of milk HACCP in the near future.

VI. Free Technical Consulting Service

A free consulting service was provided for food manufacturers now. They are welcome to talk with our relevant experts face to face about the problems they encountered during food processing, packing, storing and about the quality of their products, etc. Through the judgment on the quality of raw materials and current products, on-the-spot state photograph, personnel's education background and sanitation of equipment etc., Our experts can



Fig. 4 Round table discussion on "Development and Application on Deep Sea Water in Processing Products"

offer effective solution to our best knowledge.

VII. Technical Training

To meet the stringent demands of the food industry and regulative requirements of the related government agencies, FIRDI held

various courses for the industry continuously in 2008. Most of the training programs were sponsored by the related government agencies, such as the Department of Health (DOH) and the Industrial Development Bureau (IDB). 95 training classes with 1,928 participants were accomplished in this year totally, list in table 1.



Fig. 5 GMP policy presentations to the industry



Fig. 6 GMP policy presentations to the industry

Table 1. Training courses held at FIRDI from in 2008

| Training Courses | Length of period (days) | No. of classes | No. of Participants |
|---|-------------------------|----------------|---------------------|
| 1. Evaluation & Application of HACCP | 2 | 1 | 23 |
| 2. Evaluation & Application of HACCP for Foodservice Establishments | 2 | 1 | 11 |
| 3. Establishing HACCP System | 4 | 10 | 188 |
| 4. Food Safety Control System for Milk Processing Plants | 5 | 1 | 24 |
| 5. Food Safety Control System-Food Safety | 5 | 3 | 64 |
| 6. Food Safety Control System-Food Quality Assurance | 5 | 2 | 45 |
| 7. Good Manufacturing Practice - Food Industry | 4-5 | 2 | 28 |
| 8. Internal Audit in Food Processing Plants | 3 | 1 | 10 |
| 9. Hygiene Management in the Food Factory | 4 | 3 | 59 |
| 10. Technolgy of Hygiene Management in the Food Factory | 4 | 1 | 24 |
| 11. Pest Control in the Food Factory | 2-3 | 2 | 71 |
| 12. Q.C. on Food Industry | 5 | 1 | 9 |
| 13. Integration of Food Quality Assurance System | 3 | 1 | 13 |
| 14. Prcessing Data Analysis in Food Industry | 3 | 1 | 10 |
| 15. Examintion of Completeness on Food Package | 3 | 1 | 19 |
| 16. Application of Plastic Food Package | 3 | 1 | 27 |
| 17. Inspection in Milk Processing Plants Safety Control System for Food Sanitary Managers | 2.5 | 2 | 31 |
| 18. Basic Principle of HACCP for Food Sanitary Managers | 5 | 2 | 50 |
| 19. Workshop on Foodborne Illness Investigation | 2.5 | 2 | 63 |
| 20. Inspecting in Foodservice Safety Control System for Sanitary Managers | 2.5 | 2 | 44 |
| 21. Basic Principle of Inspection for Food Sanitary Managers | 4 | 2 | 62 |
| 22. Food Safety Control System for Foodservice Establishments and Plants? | 5 | 6 | 119 |
| 21. Food Sanitation & Examination | 5 | 5 | 88 |
| 22. Sanitation & Examination of Bottled Water | 3 | 1 | 10 |
| 23. Rapid Methods in Microbial Examination | 2-3 | 2 | 45 |
| 24. Hygiene Management of the Wine Manufacture | 3 | 1 | 17 |
| 25. Examination of the Wine Products | 2 | 1 | 26 |
| 26. Good-Laboratory-Practice Management | 3 | 1 | 19 |
| 27. Workshop on Reviving & Preservation of Microbial Strains | 3 | 2 | 40 |
| 28. Training Course on Human Embryonic Stem Cells (hESCs) | 3 | 1 | 12 |
| 29. Workshop on Spawn-Making of Edible Mushroom ? | 3 | 1 | 10 |
| 30. Technology of Thermal Processing | 5 | 1 | 24 |
| 31. Management of Aseptic Processing & Packaging Technology | 5 | 1 | 15 |
| 32. Retort Operation (Horizontal Type) | 3 | 3 | 48 |
| 33. Retort Operation (Vertical Type) | 3 | 1 | 11 |
| 34. QC on Can Seaming | 4 | 1 | 14 |
| 35. Can Seamer Operation (6M type) | 9 | 1 | 5 |
| 36. Chinese Sausage Processing Technology | 1 | 1 | 7 |
| 37. Taiwanese Meat Ball Processing Technology | 1 | 1 | 14 |
| 38. Manufacturing Management of Savory Flavor and Derivative Products | 3 | 1 | 14 |
| 39. Workshop on Basic Crisis Management of Food Factory | 2 | 1 | 36 |
| 40. Training Course Commissioned by Individual Corporation | 1-5 | 20 | 479 |
| Total | | 95 | 1928 |

Southern Taiwan Service Center



The mission of the Southern Taiwan Service Center stationed in Tainan is to execute a four-years “Food Machinery Development and Process Integration Project” funded by the Ministry of Economic Affairs (MOEA). The subjects of this year are: (a) Commercially scale-up technology integration of microwave heating system for foods and (b) Hygienic design of filling system for liquid foods. These research subjects have accomplished some core technologies such as the commercial system development and process integration of microwave-assisted hot air dryer for non-fried instant noodles, studies of microwave combined infrared heat source for roasting processes, and hygienic design and validation technology of clean filling system for extending shelf life of refrigerated milk, respectively. These achievements are depicted as follows:



I. Commercial System Development and Process Integration of Microwave-assisted Hot Air Dryer for Non-fried Instant Noodles

Non-fried instant noodles are healthy to consumer due to no oil-uptake during drying process as compared with conventional fried-dry process. Currently, non-fried instant noodles use hot air drying process which contribute to longer drying time and lower rehydration rate. To solve the above mentioned problems, this project has designed a pilot scale microwave-assisted hot air dryer for non-fried instant noodles (Fig. 1). This pilot scale dryer is designed with a target throughput of 15,000 packs per hour and the drying time is within 30 minutes to remove moisture from 45% to 10% for non-fried noodles. The main features of this microwave system are as follows: (1) efficiency of microwave energy greater than 75%, (2) temperature uniformity less than $\pm 3^{\circ}\text{C}$, and (3) microwave leakage detection devices build-in for operational safety. Pilot tests of this microwave-assisted hot air dryer using cooked noodles have proved that non-fried instant noodles can be dried within 30 minutes to remove moisture from 45% to 10%



Fig. 1 Commercial experimental machine of microwave-assisted hot air dryer for non-fried instant noodles

by adjusting microwave output power of each drying stages. The resulted drying time of 30 minutes is quite efficient as compared with that of 60 to 90 minutes by using the conventional hot air drying process. Quality features of noodles after rehydrated are evaluated using texture profile analyzer and sensory evaluation.

The results showed that texture quality of non-fried instant noodles have no significant difference between the microwave-assisted hot air drying and the traditional drying process.

This pilot system of microwave-assisted hot air dryer has successfully proved its performance both in system design and process integration. Based on both microwave energy and hot air drying parameters for non-fried instant noodles, this microwave-assisted drying technology is ready for designing any specific commercial scale systems.

II. Technology of Microwave Combined Infrared Heat Source for Roasting or Grilling Process

The unique taste of roasted or grilled foods is favored by many consumers.

However, it is readily become dried, hard-shelled and scorched for a mass piece of meat when roasting due to the nature of radiation and conduction heating by conventional heat source. To shorten roasting time and to improve heating uniformity, a microwave combined infrared oven was designed to grill whole chicken or other meats for catering usage. This oven is designed with microwave energy to cook inner part of meat while infrared

heat source is used to heat the surface and providing grill texture and flavor. The benefits of the oven hybrid with microwave and infrared energy can not only keep the meat texture with crispy outside and juicy inside but also shorten the roasting time. The dimension of this institutional sized oven is 500mm(W) × 550mm(L) × 350mm(H) with a total volume of 80 liters which is able to roast 2 to 3 whole chicken at one time (Fig. 2). The oven is equipped with eight 1kW power rated infrared heaters and one 3kW microwave energy source, respectively. Both power of infrared and microwave energy are linearly adjustable from 0 to 100% with a controlling device and temperature sensors which are equipped for feedback control of oven temperature. Furthermore, a hot air conduit is built on the side wall to enhance the heat flux homogeneity within the oven cavity. The oven has been tested to show a temperature difference inside the cavity below $\pm 3^{\circ}\text{C}$ and the microwave energy efficiency is around 70%. Two whole chickens are roasted at a time in the oven with conditions as: (1) oven temperature of 140°C , 160°C and 180°C , respectively; (2) infrared heat source power of 2.8kW, 3.2kW and 3.6kW, respectively; and (3) microwave densities of 0.5W/g, 1W/g and 1.5W/g, respectively. The roasting time is set to the point when the central temperature of the chicken reached 75°C . The results showed that the process time of whole chickens roasted in the hybrid energy oven using previous stated conditions is around 9 to 21 minutes which is 60% less than that in conventional roasting process. There was no significant difference in texture, cooking loss and water holding capacity between chickens heated by hybrid



Fig. 2 Business oven model of microwave combined with infrared heat source

energy oven and those by traditional oven. However, preferred sensory results showed that chickens roasted by the hybrid energy oven has a juicier texture than those sold in market.

III. Hygienic Design and Validation Technology of Clean Filling System for Extending Shelf Life of Refrigerated Milk

Most food machinery manufacturers in Taiwan have good ability to fabricate machines, but they are short of knowledge of process know-how and hygienic design concepts, so they have difficulties to put values on their food machinery as compared with machinery fabricated by manufacturers of Japan, American and European countries. It was proposed that if hygienic design standard and process control procedures were brought into food process machinery, the technical level and value could be improved. The results of a good hygienic practiced and process controlled machine will contribute to ensure food safety with less contamination during process. A good example is the research subject of this year to design an ultraclean filler of refrigerated milk for extending shelf life from 7 days to 30 days. In this study, filling devices of filler were redesigned with hygienic design concepts. In conventional filler design, filling

devices are in contact with containers while filling stage. Product is filled in full to the container and the excess product is continuously sucked out by an overflow device.

The problems of this kind of filling device are that many mechanical moving parts have to be placed inside the product conduit which will result in many hard-to-clean spots. The primary redesign of the filling device is the non-contact filling device which uses a magnetic flow meter to control volume so product conduit can be designed as simple as possible to reduce mechanical moving parts and dead spots for readily cleaning. The filling device is also designed with improved CIP (clean-in-place) and SIP (sterilization-in-place) procedures to reduce microbial contamination.

The commissioning test of the filling device showed that the filling time of a 600 mL bottle could be completed in 4.7 seconds and the inaccuracy was merely 0.67%. To validate the hygienic degree of the designed filling valve, a method of adhering thermal denatured protein as soil to the object was developed. After the

soil was implanted to the object, a standard CIP (clean-in-place) procedure was implemented and then the device was disassembled to observe surface cleanliness. The result showed that the degree of surface cleanliness achieved a level of no residual soil by visual observation. Furthermore, the filler was designed with SIP (sterilization-in-place) procedures of 125°C for 30 minutes to decontamination microorganisms (Fig. 3(a) and (b)).

As for designing chemical disinfection procedures for the specific filler or containers, kinetic parameters (D and z value) of target microorganism such as *Bacillus cereus* spore while applying chemical sterilants i.e. hydrogen peroxide (H₂O₂) and peracetic acid in various concentration and temperatures need to be established. As long as the sterilizing kinetic parameters database of target microorganism has been implemented, designing the degree of filler disinfection to a specific log cycle reduction can be estimated.

By the same token, filler sterilizing efficiency can be validated.



Before cleaning



After cleaning

Fig. 3 (a) Cleanness validation of contact filling device



Before cleaning



After cleaning

Fig. 3 (b) Cleanness validation of non-contact filling device

Planning Office



The Planning Office focuses on surveying trends in the food industry and nationwide food consumption, establishing a food safety information and food knowledge database, planning food industry research and development, and performing food market survey and research services. The research projects, including those that Industry Technology Intelligence Service (ITIS) carried out in this office in 2008, were jointly funded by the Council of Agriculture (COA), Ministry of Economic Affairs (MOEA), and Department of Health (DOH). Work conducted this year was dominated by maintaining and upgrading the contents of the food industry database over the Internet, as well as publishing the monthly journal of Food Market Information, the Almanac of Food Consumption for Taiwan 2008, Almanac of the Food Industry for Taiwan 2008, Food Industry Statistics Data Book 2008, Food Industry in Taiwan 2008, and various other research reports. The major achievements of these works are summarized as follows.



Planning Office

I. Current Status of the Taiwanese Food Industry in 2008

Due to the increasing prices of global food materials, the production value of the food industry in Taiwan increased by over 10%, to reach about 211.1 billion NT dollars of food value-added, in 2008. The major sectors achieving rapid growth in production value were processed vegetables, flour milling products, animal feed, animal slaughtering, noodles, and edible fats and oils, while the sectors exhibiting the main declines included frozen and chilled meats, frozen and chilled vegetables, refined teas, beer and other alcoholic beverages. The value of both imports and exports of processed foods increased over 10% in 2008, with imports of pickled and preserved foods, frozen foods, slaughtering products, and edible fats and oils exhibiting significant growth, as did exports of rice milling products, dairy products, cocoa products, canned foods, and frozen foods. Due to declining raw materials prices and the recent economic recession, the food industry may experience a slight decline in production value during 2009. The food industry thus may pay attention to nature, health, and functionality in product development, and can adopt cooperation and even merger strategies as part of its future development path.

II. Development of the Non-alcoholic Beverage Industry in Taiwan

The beverage industries adjusted product prices and used alternative materials to

decrease costs and thus ease pressures from significant increases in raw materials prices. Their operating strategies included multiple steps of price adjustment, repackaging, and introduction of new products. Price adjustment included individual price increases each time for single or multiple products during different periods, or price increases only in the case of best-selling products. Furthermore, package adjustment included increased package size and changes in packaging materials. Moreover, new product development included development of new products based on new formulas and/or new package materials to increase product value, and thus maintain or increase product price. Previous research found that the beverage industry treated new product development seriously, and also made strong efforts to maintain existing products and brands. They decreased new product launches, but made increased efforts to increase product value particularly for functional and healthy image products. For further development, the beverage industries tend to develop products with new flavor and healthy characteristics, to compete with other enterprises in developing new beverage categories with new functions, and to develop healthy sparkling beverages with new taste for new products.

III. Business Model Integration and Innovation for the Food Industry and the Preventive Medicine Industry

Countries with aging populations, high

medical expenditures and increasing health awareness must encourage the development of preventive medicine. This study investigated the status of the preventive medicine industries of the United States and Japan. The findings reveal the need to integrate food into preventive medicine in Taiwan, as the healthcare community is gradually accepting the concept of preventive medicine. This study also applied the concept of value net to explore how food and preventive medicine can be integrated with government research in epidemiology, complementary and alternative medicines, detective products, insurance, drugs and nutrition fortified foods. This study indicated that value net could benefit from government involvement. Moreover, this study further applied the value chain approach to intensify the food industry value chain. With the development of Nutrigenomics, this study predicts future changes in the food industry and the integration of the novel business model of the food industry and the preventive medicine. This study strongly recommends the inclusion of food in models of preventive medicine, focusing on research and development related to food nutrition, with cooperation models among government, industry and academia, and finally constructing an R&D platform for the food and pharmacy industries.

IV. Biofiber Development and Value-added Exploitation

The numerous possible biofiber materials include agricultural products and waste, wood, animal products and microorganisms. Biofiber development offers environmental, functional and economic benefits for many industries.

Given current trends in global green development, Taiwan should clarify its own position and the direction of biofiber development. This study surveyed related research and systematically explored types and characteristics of biofiber, and their applications in both food and non-food industries. As biofibers have various sources, usages, functions, and technologies, in face of multiple sources of raw materials supply, and fields of application, this study provided information on technology research, production development and industrialization as a basis and reference for further biofiber studies. This study found that bifiber products showed different steps in their life cycles as they progressed towards commercialization.

Dietary fiber products matured, and began to attract the general public as well as niche consumers. Weight control foods and functional health foods may be the mainstream biofiber products in future. Bacterial cellulose has long been used for sweet foods such as pudding and so on. Membrane for beauty applications is a biofiber product currently under development. Artificial skin, organs and spray material for bio-medical applications possess considerable potential provided products are successfully commercialized.



Fig. 1 2008 Conference on New Opportunities for the Food Industry

Biofiber products are heavily reliant on breakthroughs in basic research, benefits derived from obscure materials, and strong government support in product commercialization.

V. Exploring the Impact of New Services on Value-added

This study, in cooperation with the Industrial Technology Research Institute (ITRI), applied the case study method to explore key drivers of and changing dimensions related to new service innovation. This study constructed the required resources for new service development and also clarified the impact of new service development on value creation. Based on the results of this study, this work concluded the following: (1) New services are developed through changes in the supply chain and market pressures. (2) Service innovation contributes positively to firms and assists them with value creation. (3) Few firms directly and significantly contribute to GDP growth, and service innovation indeed does not guarantee the positive impact of value-add (i.e., GDP growth) in the short run. (4) Government may determine the types of service innovation worth encouraging based on its objectives in relation to service industry development

VI. Study of Co-competition Between Food Manufacturers and Retailers in Taiwan

The study reviewed the interaction between food manufactures and retailers and found that manufacturers may have different strategies and action plans when involved in



Fig. 2 2008 Conference on the Global Food Economy and the Food Industry

different co-competitive relationships. Based on the results of this study, suggestions for food manufacturers include: (1) Manufacturers in low degree of co-competition facing retailers with strong marketing power tend to sell products to niche markets instead of via mainstream channels. Such manufacturers tend to develop specialty products for niche markets. Manufacturers should focus on products for niche markets, and implement differentiation strategies to market their products in emerging and diversified markets. (2) Manufacturers facing strong co-competition may pursue win-win cooperative relationships with retailers to help retail channels in differentiating their business. Meanwhile, such manufacturers can pay attention to their brand management, regularly introduce new products, develop new brands, and even develop new operational models based on their core brand products. (3) Manufacturers showed opposite characters when involved in competitive relationships. The first kind of manufacturers possesses famous brand names, and these manufacturers should establish brand alliances with famous international brands to strengthen their brand equity. The second kind of manufacturers are

small scale producers with their own factories, and should pay attention to developing products for niche markets, and on managing special products in emerging channels. (4) Manufacturers involved in cooperative relationships can provide own brand products.

Such manufacturers should consider cost structure and market competition from the perspective of long-term development, and should prepare early to differentiate their products in terms of quality, packaging, and price to avoid their own brand products declining due to future competition from private brand products offered by retailers.

VII. Food Industry Clusters in Taiwan - The Case of the Food Machine Industry

The development of industrial clusters in Taiwan has been highly diverse. However, food industry clusters are rarely studied. This study revealed that the industry cluster of food machinery characterized with center-satellite system. Food machinery manufacturers were less dependent on each other. Although food machine manufacturers are concentrated in Central Taiwan, food industry clusters are not concentrated in a single region. Some food industry clusters are located near material supply areas, while others are located near downstream markets. Food industry clusters in Northern Taiwan choose their locations primarily because of this region being a major population center, and manufacturers have invested more in this region in terms of labor and R & D resources than they have elsewhere. Therefore food industry clusters in Northern Taiwan exhibit higher output value than those

located elsewhere in Taiwan. This study recommends that industrial innovation is the key path for continued development. Exploiting local resources is essential for shaping the characteristics and competitiveness of food industry clusters. Such a cluster would facilitate interaction between food manufacturers and improve R & D capabilities.

VIII. Supply of Vegetarian Food Products in Taiwan

The study interviewed 150 suppliers of vegetarian products in Taiwan, including those engaging in vegetarian restaurants, vegetarian food stores and vegetarian food processing factories, and found that the supply of vegetarian foods in Taiwan is dominated by prepared vegetarian foods, followed by vegetarian food materials and semi-processed products, vegetarian sauces, and vegetarian bakery foods. Approximately 65.5% of customers were familiar to suppliers, with vegetarian food factories comprising 74.3% of customers familiar to them, while vegetarian food stores 65.4%, and vegetarian food restaurants 59.3%. Vegetarian food suppliers stressed cleanliness and sanitation, service quality, product diversity, price and nutritional value in managing the vegetarian food business. Their specialty products were priced inversely to production quantity, with sales decreasing 0.3% in response to each 1% price increase. Most vegetarian food suppliers predicted a bright future for the manufacture of vegetarian food products in Taiwan, and recognized that vegetarian foods with CAS certification fit the needs of modern customers, and moreover would help increase food

hygiene, safety, and quality. CAS certification can help increase the selling price of vegetarian foods, on average providing an additional 12.7% margin compared to equivalent products without CAS certification. This study demonstrates that vegetarian food products with the certified agricultural standard (CAS) logo can help providers obtain better prices, help increase shopper confidence in vegetarian food products, and thus provide a more suitable environment for further developing the vegetarian food industry.

IX. Market Size and Consumption Behaviors of Dinners Away from Home Among Various Age Groups in Taiwan

This study used food consumption survey data to explore the consumption behaviors of dinners away from home by age group, and also estimated the size of the dining away from home market in Taiwan, finding that approximately 73.5% of consumers had eaten dinner outside of the home during the past year.

Furthermore, approximately 16.6% ate dinner outside the home every day. People in the 20-29 year old age group ate dinner outside the home most frequently, while those in the 50-59 year old age group ate dinner outside the home least frequently. The annual rate of eating dinner outside the home increased from 23.6% to 29.4% during the past seven years, and revealing growing demand for dinner outside the home in Taiwan. Most people bought dinner at fast food restaurants and independent/chain restaurants, followed by night market food stands, chain convenience stores, and supermarket and hypermarkets. Young people tended to buy dinner at fast food restaurants and independent/chain restaurant, while older people tended to buy dinner at chain convenience stores and supermarkets and hypermarkets. The market size of the commercial dinner market was estimated at around 151.68 billion NT dollars during 2007, with the main customers being in the 20-29 year old age group, and the elderly being a very minor customer group.



Fig. 3 2008 ITIS outstanding publication award



Fig. 4 2008 Conference on Food Safety and Industry Development

Publication



(I) SCI (Science Citation Index) Papers

1. Chang, C.L., Lin, M.E., Hsu, H.Y., Yao, C.L., Hwang, S.M., Pan, C.Y. and Lee, H.Y. 2008. Lysophosphatidic acid-induced interleukin-1 β expression is mediated through Gi/Rho and the generation of reactive oxygen species in macrophages. *J. Biomed. Sci.* 15: 357-363.
2. Chen, C.H., Wei, H.J., Lin, W.W., Chiu, I.W., Hwang, S.M., Wang, C.C., Lee, W.Y., Chang, Y. and Sung, H.W. 2008. Porous tissue grafts sandwiched with multilayered mesenchymal stromal cell sheets induce tissue regeneration for cardiac repair. *Cardiovas. Res.* 80: 88-95.
3. Chen, C.P., Lee, M.Y., Huang, J.P., Aplin, J.D., Wu, Y.H., Hu, C.S., Chen, P.C., Li, H., Hwang, S.M., Liu, S.H. and Yang, Y.C. 2008. Trafficking of multipotent mesenchymal stromal cells from maternal circulation through the placenta involves vascular endothelial growth factor receptor-I and integrins. *Stem Cells* 26: 550-561.
4. Chen, Y.L., Chen, H.C., Chan, H.Y., Chuang, C.K., Chang, Y.H. and Hu, Y.C. 2008. Co-conjugating chondroitin-6-sulfate/dermatan sulfate to chitosan scaffold alters chondrocyte gene expression and signaling profiles. *Biotechnol. Bioeng.* 101: 821-830.
5. Chen, Y.P., Chen, I.C., Hwang, I.E., Yuan, G.F., Liaw, L.L. and Tsang, C.P. 2008. Selection of an effective red-pigment producing *Monascus pilosus* by efficient transformation with aurintricarboxylic acid. *Biosci. Biotechnol. Biochem.* 72: 3021-3024.
6. Chen, Y.P., Tseng, C.P., Chien, I.L. Wang, W.Y., Liaw, L.L. and Yuan, G.F. 2008. Exploring the distribution of citrinin biosynthesis 1 related genes among *Monascus* species. *J Agric. Food Chem.* 56: 11767-11772.
7. Chen, Y.P., Tseng, C.P., Liaw, L.L., Wang, C.L., Chen, I.C., Wu, W.J., Wu, M.D. and Yuan, G. F. 2008. Cloning and characterization of monacolin K biosynthetic gene cluster from *Monascus pilosus*. *J. Agric. Food Chem.* 56: 5639-5646.
8. Cheng, M.J., Wu, M.D., Chen, I.S. and Yuan, G.F. 2008. Secondary metabolites from the mycelia of the fungus *Monascus pilosus* BCRC 38072. *Chem. Pharm. Bull.* 56: 394-397.
9. Chiu, S.H., Chen, C.C. and Lin, T.H. 2008. Using support vector regression to model the correlation between the clinical metastases time and gene expression profile for breast cancer. *Artif. Intell. Med.* 44: 221-231.
10. Fang, H.L., Lai, J.T. and Lin, W.C. 2008. Inhibitory effect of olive oil on fibrosis induced by carbon tetrachloride in rat liver. *Clinical Nutrition* 20: 1-8.
11. Huang, C.H., Lee, F.L. and Tai, C.J. 2008. A novel specific DNA marker in *Saccharomyces bayanus* for species identification of the *Saccharomyces sensu stricto* complex. *J. Microbiol. Methods* 75: 531-534.
12. Kao, I.T., Yao, C.L., Chang, Y.J., Hsieh, T.B. and Hwang, S.M. 2008. Chondrogenic

- differentiation of human mesenchymal stem cells from umbilical cord blood in chemically synthesized thermoreversible polymer. *Chinese J. Physiol.* 51: 252-258.
13. Lai, J.T., Fang, H.L., Hsieh, W.T. and Lin, W.C. 2008. Protecting effect of fermented substance from *Saccharomyces cerevisiae* on liver injuries induced by acetaminophen in mice. *Biosci Biotechnol. Biochem.* 72: 2514-2520.
 14. Lee, F.L., Tien, C.J., Tai, C.J., Wang, L.T., Liu, Y.C. and Chern, L.L. 2008. *Paenibacillus taichungensis* sp. nov., from soil in Taiwan. *Int. J. Sys. Evol. Microbiol.* 58: 2640-2645.
 15. Lin, S.J., Chen, Y.H., Chern, L.L., Feng, H.H., Chen, C.C. and Chu, W.S. 2008. Large-scale production and application of leucine aminopeptidase produced by *Aspergillus oryzae* LL1 for hydrolysis of chicken breast meat. *Eur Food Res. Technol.* 227: 159-165.
 16. Lin, S.J., Hsieh, Y.F., Lai, L.A., Chao, M.L. and Chu, W.S. 2008. Characterization and large-scale production of recombinant *Streptovorticillium platensis* transglutaminase. *J. Ind. Microbiol. Biotechnol.* 35: 981-990.
 17. Uen, Y.H., Wang, Y.J., Hsu, T.M., Chen, M.H., Chan, H.Y., Ho, Y.S. and Lin, S.Y. 2008. Effects of fungal-derived high molecular weight chitosan on 5-florouracil-induced adverse reaction. *J. Bioactive Compatible Polymers* 23: 458-472.
 18. Wang, C.C., Chen, C.H., Lin, W.W., Hwang, S.M., Hsieh, P.C.H., Lai, P.H., Yeh, Y.C., Chang, Y.Y. and Sung, H.W. 2008. Direct intramyocardial injection of mesenchymal stem cell sheet fragments improves cardiac functions after infarction. *Cardiovas. Res.* 77: 515-524.
 19. Wang, L.T., Lee, F.L., Tai, C.J. and Kuo, H.P. 2008. *Bacillus velezensis* is a later heterotypic synonym of *Bacillus amyloliquefaciens*. *Int. J. Sys. Evol. Microbiol.* 58: 671-675.
 20. Wang, P.C., Lin, Y.D., Liaw, L.L., Vhern, R.S. and Chen, S.C. 2008. *Lactococcus lactis* subspecies *lactis* also causes white muscle disease in farmed giant freshwater prawns *Macrobrachium rosenbergii*. *Dis. Aquat. Org.* 79: 9-17.
 21. Wei, S.W., Chern, L.L., Wu, Y.C., Wang, Y.L., Lin, C.M. and Chiou, C.S. 2008. Foodborne disease outbreaks caused by sucrose-nonfermenting and β -galactosidase-deficient variants of *Vibrio cholerae*. *Int. J. Food Microbiol.* 122: 148-155.
 22. Wu, M.D., Cheng, M.J., Wang, B.C., Yech, Y.J., Lai, J.T., Kuo, Y.H., Yuan, G.F. and Chen, I. S. 2008. Maleimide and maleic anhydride derivatives from the mycelia of *Antrodia cinnamomea* and their nitric oxide inhibitory activities in macrophages. *J. Natural Products* 71: 1258-1261.
 23. Yeh, H.J., Yao, C.Y., Chen, H.I., Cheng, H.C. and Hwang, S.M. 2008. Cryopreservation of human limbal stem cells *ex vivo* expanded on amniotic membrane. *Cornea* 27: 327-333.

(II) Papers on Other Scientific Journals

1. Chan, Y.C., Chen, R.Y., Liao, J.W., Yang, M.D., Lai, Y.C. and Wang, M.F. Effects of catechins on learning and memory ability and liver antioxidant status in male senescence accelerated mice. *Taiwanese J. Agric. Chem. Food Sci.* 46: 78-86.
2. Lin, S.B. and Yang, H.T. A low-oxygen processing system for making fruit and vegetable juices. *Taiwanese J. Agric. Chem. Food Sci.* 46: 243-252.
3. Tung, C.H. and Chu, Y.H. Effects of supercritical carbon dioxide on β -carotene extraction in *chlorella*. *Taiwanese J. Agric. Chem. Food Sci.* 46: 207-212.

(III) Conference Papers (Internal conference)

2007 Annual Meeting of The Chinese Society of Mycology. January 5, 2008. Taipei, Taiwan.

1. Chan, F.L., Hsieh, S.Y. and Yuan, G.F. *Halophytophthora spinosa* var. *lobata*, a new record of Oomycetes from Taiwan.
2. Chen, I.C., Hsieh, S.Y. and Yuan, G.F. Xerophilic fungi, Eurotium in dry foods.
3. Chen, Y.P., Tseng, C.P., Liaw, L.L., Wang, C.L., Chen, I.C., Wu, W.J., Wu, M.D. and Yuan, G. F. Characterization of monacolin K biosynthetic gene cluster in *Monascus pilosus* BCRC38072.
4. Liu, T.W., Wu, W.J. and Yuan, G.F. Screening for female sex hormone modulators from microbial resources.
5. Tu, C.Y. and Liaw, L.L. Analysis of antifungal protein MAFP1 in *Monascus*.

2008 Conference of the Annual Meeting of the Health Food Society of Taiwan and of Liver Protectin. February 22, 2008. Taipei, Taiwan.

1. Chen, S.F. and Jane, S.T. The present status and prospect of foods with functionality of blood glucose modulation.
2. Huang, S.C. and Liao, T.S. *In vitro* glucose metabolism effects of different dietary fiber prepared from mung bean hull, rice bran and lemon peel.
3. Li, H.S. and Wang, S.M. Food preference of elder in Taiwan.
4. Li, H.S. and Wang, S.M. Degree of preference for vegetarian foods in Taiwan market.

2008 Symposium of Taiwan Regenerative Medicine Society. February 23, 2008. Taipei, Taiwan.

Chen, Y.L., Chan, H.Y., Chen, H.C. and Hu, Y.C. Co-conjugating chondroitin sulfate C/dermatan sulfate to chitosan scaffold alters chondrocyte gene expression.

Symposium on Mesenchymal Stem Cells and Regenerative Medicine. March 1, 2008. Taipei, Taiwan.

Yao, C.L. Serum-free *ex vivo* expansion of hematopoietic stem cells.

Cryo-Banking and Bio-Vtilization of Animal Cells. March 12, 2008. Taipei, Taiwan.

Hwang, S.M. Cryobanking of animal cells.

The 23rd Joint Annual Conference of Biomedical Sciences. March 29, 2008. Taipei, Taiwan.

Kuo, C.H. and Liu, T.Y. Effects of (-) – epigallocatechin-3-gallate induced oral cancer cells cytotoxieity retard by lactoferrin combination treatment.

Symposium of Applied Technology for Animal Cells. April 9, 2008. Kaoshiung, Taiwan.

Hwang, S.M. Animal cell cultivation and quality.

Conference of the New Opportunities for Food Industries in Taiwan. April 23, 2008. Taipei, Taiwan.

1. Chen, S.F. The opportunity and developments of health-enhanced foods.
2. Chen, Y.L. Green opportunity of food industry.

Symposium on *Monascus*. May 2, 2008. Taipei, Taiwan.

Yuan, G.F. Molecular biology of *Monascus*.

The 9th Annual Conference of Empirical Economics. May 17, 2008. Taipei, Taiwan.

Chen, H.C. and Chen, L.T. A study of value-added for food enterprises in Taiwan-the case of TSE and OTC firms.

Conference of Food Industry Management and Operation. May 30, 2008. Taichung, Taiwan.

Chen, Y.L. Analysis of raw material rise in price and industrial plant of the world.

2008 Cancer, Stem Cell Symposium. June 6, 2008. Taipei, Taiwan.

Hwang, S.M. Stem cells in amniotic fluid.

2008 Lactic Acid Bacteria and Intestinal Immunomodulation Symposium. June 20, 2008. Taipei, Taiwan.

Chan, H.Y., Lin, S.B., Lee, F.L., Yang, H.T., Teng, K.Y., Chiu, H.H., Huang, T.C. Wann, S.Y., Wu, S.F. and Sung, P.C. The research and application of fermented beverage with plant origin lactic acid bacteria.

Application of Fermentation Technology in Agricultural Biotech. June 26, 2008. Taipei, Taiwan.

Chan, H.Y. Application of microbial biotechnology and fermentation engineering.

The 13th Conference on Biochemical Engineering. June 27, 2008. Taoyuan, Taiwan.

1. Chen, T.W., Yao, C.L., Chu, I.M., Chuang, T.L. and Hwang, S.M. Generation and characterization of megakaryocytes from serum-free expanded human umbilical cord blood CD34⁺ cells.
2. Chuang, T.L., Yao, C.L. and Hwang, S.M. Characterization of natural killer cells induced from serum-free expanded umbilical cord blood CD34⁺ cells.
3. Kuo, C.M., Lu, T.S. and Lai, J.T. Production of CoQ₁₀ by using photobacteria mutant.
4. Lu, T.S., Kuo, C.M. and Lai, J.T. Process development of photobacteria cultivation without

illumination.

5. Yao, C.L., Chang, Y.J., Wu, M.L. and Hwang, S.M. Development of a serum-free medium for human mesenchymal stem cells.

Symposium on the Distinction, Exploration and Application of Industrial Microorganisms. June 30, 2008. Taipei, Taiwan.

1. Lee, F.L. The distinction of industrial microorganisms by using *gyrB* gene sequence.
2. Tseng, M. The exploration of polyester-degrading actinomycetes.

The 46th Annual meeting of Agricultural Chemical Society of Taiwan. June 30, 2008. Taipei, Taiwan.

1. Cheng, C.Y. Huang, M.J., Lin, Y.R. Yi, L.C. and Huang, C.C. Quantification of pork content in the frozen dumpling by real-time PCR.
2. Chi, J. R., Cheng, R. S., Chu, W. S., Pan, T. M., Gong, H. Y. and Wu, J. L. Identification of freezing-tilapia fillets in different regions with DNA markers.
3. Chien, M.C., Chiu, S.H., Chen, H.K., Lee, F.L. and Liaw, L.L. Gene cloning and protein expression of an alkaline lipase from an isolated *Proteus vulgaris*.
4. Lin, S.J., Liang, S.S., Chen, L.L., Liaw, L.L. and Yuan, G.F. Isolation, screening of agarolytic marine bacteria and cloning, sequences of its agarase gene.
5. Liu, H.C., Hung, Y.F., Lai, J.T. and Liao, C.C. Strains screening for production of carnitine.
6. Hung, Y.F., Liu, H.C., Lai, J.T. and Liao, C.C. Influence of strains mutation on production of carnitine.

2008 Workshop: Research and Status of Taiwan Species Diversity. August 15-16, 2008. Taichung, Taiwan.

1. Chen, H.K., Liou, G.Y., Wang, L.T., Lee, F.L., Lee, S.Y., Yuan, G.F. and Liao, C.C. Collection and identification of microbial resources diversity.
2. Chiy, S.H., Sung, L.M., Hung, K.J., Chan, F.L., Chen, I.C., Hsieh, S.Y. and Chen, C.C. Research and construction of polyphasic and web-based identification system for fungal species.

Symposium of Innovations in Food Industry. September 18, 2008. Taipei, Taiwan.

Huang, Q.X. Innovative trends in food industry.

2008 Annual Meeting of the Taiwan Public Health Association and Symposium on "Climate Change and Health". October 4, 2008. Taipei, Taiwan.

Chen, S.F. and Jane, S.T. The present status and prospect of foods with functionality of blood glucose modulation.

Industry Outlook of ITIS. November 11, 2008. Taipei, Taiwan.

Chen, L.T. Development and opportunities of food industries.

The 38th Annual Conference of the Taiwan Association for Food Science and Technology.
 November 21, 2008. Pingtung, Taiwan.

1. Chang, C.H., Cheng, Y.S. and Wu, J.Y. Model study for the modification of amylose with pectin.
2. Chang, C.H., Tsai, Y.T. and Chuang, C.Y. Applications of feedback control systems on microwave assisted hot air drying process in carrot cubes.
3. Chang, C.T., Hung, M.Y., Lai, H.L., Liu, Y.H., Liou, S.E., Chen, Y.H. and Chen, C.C. The application of IEF for fractionation of soy peptide with the activity of angiotensin converting enzyme inhibitor.
4. Chang, Y.P., Tung, C.H. and Chu, Y.H. Evaluation of applying wet milling technology to oil related products.
5. Chang, Y.W., Chen, Y.L. and Jane, S.T. Development and opportunity of new service for food industry.
6. Chen, C.P., Hsu, C.C., Lai, C.Y. and Yang, B.H. The research of combined microwave energy in infrared heating for roast chicken.
7. Chen, C.P., Li, M.J., Wang, Y.W. and Yang, B.H. Application of microwave on drying processing for physical quality of instant noodles.
8. Chen, H.P., Liu, T.W. and Wu, W.J. Target-based screening systems and searching for glucocorticoid receptor and thyroid hormone receptor modulator from microbial resources.
9. Chen, L.T. and Chen, H.J. A study of value-added for food enterprises in Taiwan-the Case of TSE and OTC firms.
10. Chen, L.T., Chen, Y.L. and Jane, S.T. Immigrating global value chains to Taiwan-the case of the functional ingredients.
11. Chen, Y.L. Impact of the international commodity prices on Taiwanese food industry.
12. Chen, Y.L. Analysis of instant noodle market in Taiwan.
13. Chen, Y.L. Innovation trends of food and beverage product.
14. Chen, S.F. and Jane, S.T. The trends of development and opportunity with health-enhanced foods.
15. Cheng, S.L., Chien, M.C., Tu, C.Y. and Liaw, L.L. Screening and preservation of lipase producing bacteria.
16. Cheng, T.C., Lin, T.Y. and Chu, C.L. Processing of dietary fiber enriched vegetable and fruit juice by post pasteurization enzyme hydrolysis.
17. Cheng, Y.C., Yu, C.J. and Chan, T.L. Effects of treatment methods on the taste-masking of DHA microparticles.

18. Chien, M.C. Chiu, S.H., Chen, H.K., Lee, F.L. and Liaw, L.L. Gene cloning and analysis of an esterase from an isolated *Pseudomonas pseudoalcaligenes*.
19. Chiu, T.C., Lai, J.T. and Liao, C.C. Preparation of curcuminoid loaded solid lipid nanoparticle.
20. Chou, Y.L., Liang, C.W., Chen, S.Y. and Chu, Y.H. Screening of the fermented rice bran on cardiovascular protection activity.
21. Chuang, C.Y., Li, Y.S. and Lin, F.W. Effect of drying parameters on microwave assisted hot air drying.
22. Chuang, C.Y., Tsai, Y.T., Li, Y.S., Chang, C.H., Wang, Y.W., Peng, H.C., Li, M.J., Ling, F.W. and Yang, B.B. Application of microwave assisted hot air drying process in non-frying instant noodles.
23. Hsiao, H.C., Lu, T.S., Liu, H.C. and Lai, J.T. Exploration of suspension culture for bacterial cellulose.
24. Huang, C.H., Lee, F.L. and Tai, C.J. A novel specific DNA marker in *Saccharomyces bayanus* for species identification of *Saccharomyces sensu stricto* complex.
25. Huang, M.J., Cheng, C.Y., Lin, S.R., Lu, C.Y. and Huang, C.C. Quantification of shrimp content in frozen shrimp ball by real-time PCR.
26. Huang, S.C., Liu, P.J. and Liao, T.S. The development of antihypertensive functional food from chicken blood.
27. Huang, Q.X. and Jane, S.T. Opportunities and development strategies for food machine turnkey in Taiwan.
28. Huang, J.P., Tsai, M.J., Wu, J.J. and Chen, R.Y. The extracted sesame meal (*Sesamum indicum*) with the potential to induce the phase II enzyme, quinone reductase.
29. Hung, M.Y., Liu, Y.H. and Chen, C.C. The assessment of antioxidant and ACEi peptide formation activity of black soybean fermentative fraction.
30. Ho, C.L., Luo, Y.S., Hung, B.H., Wang, I.C., Chu, C.L. and Jane, S.T. Fast serving meal assembling technique for HMR.
31. Hsiao, H.C., Lu, T.S., Liu, H.C. and Lai, J.T. Investigation on bacterial cellulose production by using suspension cultivation.
32. Hsu, H.L. and Tsai, M.J. Effects of combined *Monascus* species fermented conditions on qualities of chicken extract.
33. Kao, C.W., Peng, J.S. and Yang, B.B. A method for in-place cleanability of food processing equipment by microbiology test.
34. Li, H.S. and Wang, S.M. Prospect and operational status quo of meat processing factories in Taiwan.

35. Li, H.S. and Wang, S.M. Evaluation of CAS labeling for meat products by meat processors in Taiwan.
36. Li, H.S., Wang, S.M., Tsai, M.J. and Hsu, H.L. Two-step evaluations on processed foods for consumers in the elderly-care organization.
37. Li, H.S., Wang, S.M., Tsai, M.J. Hsu, H.L. and Teng, K.Y. Nutritionists' evaluation on issues of development of the elderly-suitable food in Taiwan.
38. Liang, C.W., Chou, Y.L., Chen, S.Y. and Chu, Y.H. Cardiovascular effects of fermented cereal products.
39. Liang, S.H. and Liaw, L.L. Gene cloning and protein characterization of *Thalassomonas agarivorans* lipase.
40. Lin, C.J., Wang, I.C., Luo, Y.S. and Jane, S.T. Studies on the inhibition of warmed-over flavor from precooked meat using plant extract.
41. Lion, S.E. and Chen, C.C. Changes of volatile compounds and maillard intermediates as affected by concentration temperature.
42. Lion S.E. and Chen, C.C. Analysis of dicarbonyl compounds in commercial carbonated beverages, liquid sweeteners and solid sweetener.
43. Liu, T.J., Chiang, W.Y., Luo, G.R., Chu, J.S. and Chu, W.S. Development of glyconutrients by lactic acid bacteria.
44. Luo, G.R., Liu, T.J., Chiang, W.Y., Chu, J.S. and Chu, W.S. The screening of fucose producing edible mushrooms.
45. Luo, Y.S., Wang, S.M., Lin, T.K., Wang, I.C., Ho, C.L. and Huang, B.H. The effect of menu and service on consumers' perception of family dinner.
46. Lung, H.M. and Peng, J.S. Different dye adding to the nutrient agar for rapid differentiation of gram-negative and gram-positive bacteria and its application.
47. Peng, X.H. and Peng, J.S. Preservation and resist chemical property analysis of *Byssoschlamys nivea* ascospore.
48. Shiao, D.S. and Chen, W.L. The seasoned soybean vegetarian meat-analog manufacturing technology by wet extrusion.
49. Teng, K.Y., Yang, H.T., Chiu, H.H., Chan, H.Y. and Lin, S.B. Application of lacto-fermentation technology on carrot juice.
50. Tsai, Y.T., Chuang, C.Y. and Chang, C.H. Applications of microwave assisted infrared rays drying process in longans.
51. Tsai, L.K., Hsu, C.C., Chang, J.J., Huang, R.C., Chang, C.H. and Yang, B.H. Dielectric properties measurement of food by using coaxial probe method.

52. Tung, C.H., Chang, Y.P. and Chu, Y.H. Estimation of plant fibers applied to oil related products.
53. Wang, S.M. and Li, H.S. Food style of 40-80 year old ages in Taiwan.
54. Wang, L.K., Huang, L., Wang, C.L., Chuang, Y.C. and Chu, W.S. Screening of bacteria with thermostable β -glucosidase activity and gene cloning of the enzyme.
55. Wang, Y.W., Peng, H.C. and Lin, F.W. Microwave assisted hot air drying process in pellet.
56. Wang, P.M., Shen, Y.W., Chiu, H.H., Hung, M.Y., Chuang, S.C., Chen, C.C. and Chan, H.Y. Manufacture of high-content soybean oligosacchrides by lactic acid bacteria.
57. Wu, N.J., Chang, H.W. and Tsai, M.J. Effects of micronization on glucose metabolism *in vitro* of broccoli.
58. Yang, H.T., Chiu, H.H., Teng, K.Y., Yu, L.W., Wang, P.M., Chan, H.Y. and Lin, S.B. Scaling-up techniques of fermented vegetable and fruit juice.
59. Yen, T.Y., Chen, C.P. and Peng, J.S. Quantification analysis of chemical sterilant peroxyacetic acid.

2008 (20th) Analysis Science and Technology of Food Hygiene Seminar. November 24, 2008. Taipei, Taiwan.

Cheng, C.Y., Huang, M.J., Chiu, H.C., Liu, S.M. and Huang, C.C. Simultaneous detection of *Staphylococcus aureus*, *Salmonella*, *Bacillus cereus* and *Vibrio parahaemolyticus* by multiplex real-time polymerase chain reaction.

19th Annual Meeting, Taiwan Society of Microbiology. November 29, 2008. Taipei, Taiwan.

Hoang, K.C. and Tseng, M. The study of actinocytes *Actinomyces* sp., degrade poly (L-lactide) (PLA).

The Irreplaceable Value of Fermented Milk Symposium. December 5, 2008. Taichung, Taiwan.

1. Chiu, H.H., Sun, P.C., Chan, H.Y. and Liao, C.C. Establishment of data base for lactic acid bacteria with immune activity.
2. Huang T.C., Wann, S.Y., Wu, S.F., Sung, P.C., Chan, H.Y. and Liao, C.C. Development of exopolysaccharides(EPS) products by lactic acid bacteria.
3. Peng, H.J., Liang, S.S., Chan, H.Y., Liaw, L.L. and Liao, C.C. The establishment of lactic acid bacteria genomic DNA resources.

2008 Annual Conference of Agricultural Economics. December 13, 2008. Taipei, Taiwan.

Chen, L.T. and Chen, H.J. A study of value-added for food industry in Taiwan.

Chen, L.T. and Chiueh, Y.W. Consumer willingness to pay for certified fishery products.

Forum on Southern Taiwan Agricultural Biotechnology. December 24, 2008. Tainan, Taiwan.

Lin, S.B., Teng, K.Y. and Yang, H.T. Development of hippocratic vegetable and fruit juices.

2008 Annual Meeting of Mycological Society of Republic of China. December 27, 2008. Taichung, Taiwan.

1. Chen, Y.P., Chen, I.C., Hwang, I.E., Yuan, G.F., Liaw, L.L. and Tseng, C.P. Selection of a high red pigment-producing *Monascus pilosus* by efficient transformation with aurintricarboxylic acid.
2. Chen, Y.P., Tseng, C.P., Chien, I.L., Wang, W.Y., Liaw, L.L. and Yuan, G.F. Exploring the Distribution of citrinin biosynthesis related genes among *Monascus* Species.
3. Hsieh, S.Y., Chan, F.L., Lee, C.Y. and Yuan, G.F. Development of *Termitomyces* and nests of termites.
4. Hsieh, S.Y., Chan, F.L., Yuan, G.F. and Wu, C.G. Reproduction and development in *Monascus*.
5. Liou, G.Y., Wei, Y.H., Lin, S.J., Wen, C.Y. and Lee, F.L. *Pseudozyma pruni* sp. nov., a novel ustilaginomycetous anamorphic fungi in Taiwan.
6. Wu, M.L., Hsieh, S.Y. and Su, Y.C. Two new species of *Incrucipulum* from Taiwan.

(IV) Conference Paper (International conference)

International Conference of Advanced Research on Marine Bioresources. May 8, 2008. Keelung, Taiwan.

Chi, J.R., Huang, C.W., Cheng, R.S., Chu, W.S., Gong, H.Y., Pan, T.M. and Wu, J.L. An efficient method of genotyping to identify *Tilapia* species by microsatellite DNA markers.

International Society for Biological and Environmental Repositories Annual Meeting & Exhibits. May 18-21, 2008. Bethesda, Maryland, USA.

Yeh, H.J. and Hwang, S.M. Alternative and inexpensive tool of cell freezing for cryopreservation.

1st Pan Pacific Symposium on Stem Cells Research 2008. June 1, 2008. Taichung, Taiwan.

Yao, C.L. Serum-free expansion and differentiation of hematopoietic stem cells.

6th ISSCR Annual Meeting. June 11, 2008. Philadelphia, USA.

Hung, C.J., Wu, M.L., Hsu, L.W., Yao, C.L. and Hwang, S.M. Establishment of two immortalized mesenchymal stem cell lines by exogenous expression of telomerase reverse transcriptase.

World Food Shortage Conference, the 4th Malaysia International Agro-Bio-business Conference 2008. July 11, 2008. Kuala Lumpur, Malaysia.

Chu, C.L., Lin, S.B., Tsai, M.J., Chang, H.W. and Chen, W.L. Increasing yield of processed food production through technology innovation.

236th ACS Annual Meeting, Symposium : Chemistry Texture and Flavor of Soy. August 17, 2008. Philadelphia, USA.

Lai, H.S., Chien, F.N., Chuang, S.C., Chen, Y.H. and Chen, C.C. Bioactive peptides isolated from soy hydrolysate in stimulating CCK induced satiety.

International Symposia on Stem Cells, Epigenetics and Development. September 27, 2008. Taipei, Taiwan.

1. Hsu, L.W., Shen, C.N., Hsu, L.F., Chang, Y.J., Tsai, M.S. and Hwang, S.M. Multilineage Potentials of Side Population Cells from Human Amniotic Fluid.
2. Hung, C.H., Wu, M.L., Cheng, F.C., Wang, T.H. and Hwang, S.M. Establishment of mesenchymal stem cell lines with telomerase reverse transcriptase and red fluorescent gene expression.
3. Yao, C.L., Chang, Y.J., Wu, M.L. and Hwang, S.M. Characterization of expanded mesenchymal stem cells in the serum-free medium.

APEC-ATCWG International Workshop on "Capacity Building for Development and Implementation of Risk Management Systems on Plant Genetic Resources for Food and Agriculture". October 17, 2008. Taichung, Taiwan.

Liao, C.C. Risk management on microbial genetic resources in BCRC/FIRDI of Taiwan.

4th Congress of the Federation of Immunology Societies of Asia-Oceania(FIMSA 2008). October 17, 2008. Taipei, Taiwan.

Chen, S.W., Chang, Y.Y., Chen, C.H., Lin, C.J. and Wu, R. Modulating immune responses of *Lactobacillus johnsonii* EM1 in BALB/c mice.

14th World Congress of Food Science and Technology. October 19-23, 2008. Shanghai, China.

1. Chuang, S.C., Chen, Y.H., Lai, H.L., Hung, M.Y., Chang, C.T. and Chen, C.C. Proteolytic soy hydrolysate inhibits the formation of advanced glycation endproducts.
2. Liang, C.W., Chou, Y.L., Peng, H.T. and Chu, Y.H. A study *in vitro* of fermented soybean hypocotyls and hulls on cardiovascular health.
3. Chu, C.L. Reuse of process-water in the food industry.

2008 Multicountry Observational Study Mission on Waste Management in the Food-Marketing and Processing Sectors. November 4-11, 2008. Tokyo, Japan.

Tung, C.H. Food-processing waste management in Taiwan, ROC.

2008 Annual Conference of Tissue Engineering and Regenerative Medicine International Society-Asian Pacific Region. November 6-8, 2008. Taipei, Taiwan.

Yuan, C.C., Ma, K.J., Tseng, C.P. and Hwang, S.M. The nanogrooved surface enhances myotube formation.

International Society for Nutraceuticals & Functional Foods 2008 Annual Conference "Nutraceuticals, Functional Foods and Dietary Supplements". November 14-17, 2008. Taichung, Taiwan.

1. Chang, H.W. and Tsai, M.J. Effects of particles sizes of vegetable and fruit fibers on intestinal

physiology.

2. Chen, C.H. and Chen, S.W. Hypoglycemic effects of polygonum hypoleucum extracts.
3. Chang, Y.Y., Wu, N.J. and Chen, S.W. Effects of micronization of fruit juice on intestinal microflora.
4. Lai, H.L., Chuang, S.C., Chen, Y.H. and Chen, C.C. Bioactive peptides derived from soy proteins.
5. Lin, Y.S., Chang, M.Y., Chen C.H., Chen, S.W. and Chao, P.M. Finding a herb with acetyl-CoA carboxylase inhibitory activity and evaluating its potential in treating metabolic syndrome.
6. Chu, J.S., Luo, G.R., Chiang, W.Y., Liu, T.J. and Chu, W.S. The screening of potentially fucose containing EPS producing strains from lactic acid bacteria and edible mushrooms.
7. Sheu, F.H. and Tsai, M.J. Decreasing the purine content of mushroom extract by enzyme and ion exchange resins.
8. Sheu, F.H., Wen, C.Y., Chen, J.T. and Tsai, M.J. Decreasing the purine content of mushroom extract by fermentation method.
9. Tsai, H.Y. and Chen, S.W. Screening for anti-obesity agents.

International Symposium on Innovations in Food Processing. November 20, 2008. Pington, Taiwan.

Wu, J.Y., Tzen, L.S., Chang, C.H., Cheng, Y.S. and Huang, B.H. Innovation of grain products by extrusion.

2008 Taiwan/Korea/Japan CHE Conference and 55th TwIcHE Annual Conference. November 20-22, 2008. Taipei, Taiwan.

Ho, C.C., Yeh, H.J. and Lai, J.T. Examination of physical properties and cell toxicity for modified PVA-cellulose.

2008 International Symposium on *Monascus* (*Monascus* 2008) December 16-17, 2008. Taipei, Taiwan.

1. Chen, Y.L., Chen, M.H., Chen, K.P., Hsu, H.Y., Chan, H.Y., Huang, T.K. and Yuan, G.F. Optimization of fermentation condition for γ -aminobutyrate production by *Monascus purpureus*.
2. Chen, Y.L., Chen, M.H., Chen, K.P., Hsu, H.Y., Hsu, H.Y., Huang, T.K. and Yuan, G.F. Strain improvement of *Monascus purpureus* for yellow pigment production.
3. Chen, Y.P., Chen, I.C., Hwang, I.E., Yuan, G.F., Liaw, L.L. and Tseng, C.P. Selection of a high red pigment-producing *Monascus pilosus* by efficient transformation with aurintricarboxylic acid.
4. Chen, Y.P., Tseng, C.P., Chien, I.L., Wang, W.Y., Liaw, L.L. and Yuan, G.F. Exploring the

distribution of citrinin biosynthesis related genes among *Monascus* Species.

5. Chen, Y.P., Tseng, C.P., Liaw, L.L., Wang, C.L., Chen, I.C., Wu, W.J., Wu, M.D., Yuan, G.F. Cloning and characterization of Monacolin K biosynthetic gene cluster from *Monascus pilosus*.
6. Chen, Y.P., Tseng, C.P., Liaw, L.L., Wang, C.L. and Yuan, G.F. Characterization of MRT, a new non-LTR retrotransposon in *Monascus* spp.
7. Chen, C.C., Wang, C.L., Sung, L.M., Chiu, S.H., Chiu, T.P., Yuan, G.F., Chu, W.S. and Liao, C.C. Sequencing and analysis of *Monascus pilosus* genome.
8. Cheng, M.J., Wu, M.D., Chen, I.S., Tseng, M. and Yuan, G.F. Metabolites Isolated from *Monascus purpureus* BCRC 38113.
9. Chiu, S.H., Chen, C.C. and Yuan, G.F. Diversity of polyketide synthase gene sequences in *Monascus pilosus*.
10. Hsieh, S.Y., Chan, F.L., Yuan, G.F. and Wu, C.G. Ascona development and ascospore germination in *Monascus*.
11. Liou, G.Y., Lee, C.Z., Wei, Y.H., Chen, C.C., Liu, H.Y., Lee, F.L. and Yuan, G.F. Differentiation of *Monascus purpureus* and related species by DNA-DNA hybridization and RAPD.
12. Tu, C.Y., Hwang, I.E. and Liaw, L.L. The application of *Monascus* microarray.
13. Tu, C.Y. and Law, L.L. The study of antifungal protein MAFP1, in *Monascus*.
14. Wang, J.C., Huang, L., Sung, L. M. and Chu, W.S. Development of *Monascus* proteomics.
15. Wang, P.M., Development of a fed-batch cultivation strategy for the production of *Monascus* pigment.
16. Wang, C.L., Sung, L.M., Chiu, T.P., Chen, C.C. and Yuan, G.F. Information platforms for *Monascus* genome and proteome.
17. Yuan, G.F., Chen, Y.P., Chen, C.C., Liaw, L.L., Chu, W.S. and Liao, C.C. The *Monascus* genome project and the gene study.
18. Yuan, G.F. and Liao, C.C. Capacity building of R&D service for *Monascus* industry.