INDUSTRIAL TECHNOLOGY DEVELOPMENT INSTITUTE
DEPARTMENT OF SCIENCE AND TECHNOLOGY

AnnualReport2015

Philippines: A Science Nation Innovating For Global Competitiveness

"Our Business Is Industry..."

The Industrial Technology Development Institute (ITDI)

laid the groundwork for S&T in the country. Today, it is one of the DOST's R&D agencies and undertakes multidisciplinary industrial R&D, technical services, and knowledge translation or technology transfer/ commercialization. ITDI harnesses know-how in new technology and product innovation, and through the years, has emerged as a credible and reliable industry and government partner in accelerating growth and development in the country.

Vision: Excellence in propelling development as provider of technologies and services for industry

Mission: To make local industries globally competitive

Mandate

- Conduct R&D to generate new knowledge and technologies
- Undertake knowledge translation or technology transfer/commercialization
- Provide technical services, tests, and analyses
- Establish, develop, and maintain national units of measure to provide international traceability

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message of the SECRETARY

I would like to congratulate the Industrial Technology Development Institute (ITDI) for a successful 2015. The Institute, under the Department of Science and Technology (DOST), has again proven its significance in addressing science, technology, and innovation of Philippine industries.

It is noteworthy to recognize that the ITDI was awarded by the National Academy of Science and Technology (NAST) as the Best Institute registering the most number of utility models as outputs of its numerous research undertakings for the period 2014-1015.

The Institute was a prominent leader in the provision of advanced systems and facilities for technical services to enhance industry development in the country. Continuing the efforts of the DOST to catalyze food industry development by championing the newly instituted facilities in the regions during the National Science and Technology Week (NSTW) celebration, Nationwide Science Tour, and staging the Food Innovation Center and DOST-developed food process equipment in the international platform during the Salon International de l' Agroalimentaire (SIAL) ASEAN MANILA 2015.

In line with the DOST's goal in disaster mitigation, support for disaster preparedness is an essential undertaking of ITDI. The 'Pack of Hope', a ready-to-eat chicken *arroz caldo* developed by ITDI for calamity-stricken areas, was given a KATHA certificate of recognition by the International Food Exhibition Awards Committee for product and packaging innovation.

Moreover, the Institute illustrates its commitment to provide competent results of calibrating and testing by sustained certification of its laboratories with ISO 17025:2005. Internationally recognized competencies on testing and calibration services of ITDI were again enhanced in 2015.

It is my firm belief that the Institute will continue to be a strong force in helping local industries to become globally competitive, helping improve the quality of life of the Filipino people.

Mabuhay!

Mario G. Montejo
Secretary, DOST

message of the DIRECTOR

We are pleased to present the 2015 ITDI Annual Report. The year proved to be both enlightening and fruitful. The ITDI continues to be a working titan of the Philippine industry at 114 years consistent with its mantra – 'our business is industry'. The Institute in 2015 made significant contributions in five of DOST's 8 Outcomes namely: (1) agricultural productivity; (2) MSMEs competitiveness; (3) local industry facilities and capabilities modernization; (4) health and wellness; and (5) disaster preparedness.

Contribution was made to technology and innovation in the field of packaging for local agricultural produce for increased productivity. Shelf life of fresh cut fruits and vegetables, including pineapple, papaya, cabbage, and jackfruit were extended for more than double using modified atmosphere packaging (MAP) coupled with cold chain. Likewise, MAP was utilized to prevent migration of the sought exotic flavors of durian in the frozen state. Transport packaging technology was used to increase the portativity and therefore the marketability of semi-processed fruits and vegetables including solo papaya, queen pineapple, sweet potato, and broccoli. This improved packaging technology significantly decreased postharvest losses of these products by at least 20%.

In support of the MSMEs, significant contributions were done to upgrade the local cacao, cassava, and selected fruit processing industries. Capability upgrading of the Philippine cacao industry was made thru improvement of processing procedures and quality criteria for cacao and cacao products and; design and fabrication of appropriate equipment for this industry. Heat stable pre-gelatinized cassava flour was developed using drum drying technology with the resultant flour as possible functional ingredient in various heat processed food systems as binder, filler, thickener, emulsifier and extender. The drum drying technology was further utilized to prepare dehydrated mango, banana, and coconut sport (*makapuno*) products that can be alternatively used both as consumer or intermediate food materials. The inertia in new food product development throughout the country was driven with the institution of food innovation centers (FICs) in all regions of the country which are equipped with the necessary manpower and equipment support. Promotion of locally designed and fabricated food processing equipment became a necessary but welcomed off-shoot of the establishment of the FICs. The FICs are envisioned as catalysts for the increased appreciation of local agricultural raw materials for innovative Philippine processed food products for the MSMEs.

Introductions of more advanced science, technology and innovation for industrial use in the form of facility and capability were also the focus of the 2015 initiatives of ITDI. The Institute is a partner in the creation and implementation of One Lab as a working framework that allows the harmonization, interfacing and integration of technical services and other assistance from all the DOST laboratories in collaboration with other significant private and government laboratories. One Lab is designed to efficiently address testing needs of the Philippine industries based on virtual connectivity underpinned by a referral system. Nanotechnology researches were also pursued starting from synthesis, production, and modern applications of nanomaterials like nanozeolite and nano-precipitated calcium carbonate. Impregnation of molecular sieves with nanozeolite for purification of fuel-grade ethanol, CO_2 capture system, and oil removal in wastewater is an example. Nano-precipitated calcium carbonate was evaluated as an additive for reinforced thermoplastics.

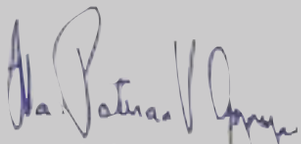
Health and wellness researches of ITDI included; (1) screening of local flora as material for extract-based larvicidal control agents of Dengue-causing mosquitoes, (2) method development for testing packaging materials health-noxious substances, and (3) capacity building of Regional Bantay Asin Task Force to support the program initiatives of the National Salt Iodization Program.

For disaster preparedness initiatives, the ITDI implemented field testing and validation study of retort food (chicken porridge) as a relief food using DSWD's and LGU's distribution protocols, and production and nationwide dissemination of candle-type ceramic water filters for disaster affected areas.

During the year, ITDI made a total income of PhP 33,063,391.34 from its various technical services that helped improve operations and processes of our clients. Likewise, we continued pushing for the application of our research results in the production sector. For this year, ITDI has transferred 12 technologies to a total of 26 recipients.

2015 was in fact a very productive year for ITDI. What has been presented was just a glimpse of our actual accomplishments for the year. The Institute will continue to serve the country in the coming years by being significant to the local industry.

Mabuhay!



Maria Patricia V. Azanza, Ph.D.
Director, ITDI

OUTCOME 1

Science-based know-how and tools that enable the agriculture sector to raise productivity to world-class standards

In support to the agricultural sector of the country, ITDI developed and improved packaging technologies aimed at enhancing the sector's productivity. Through shelf life extension and distribution and handling losses reduction, Philippine produce continues to widen further its market reach.

Development of **transport packaging technology** for fresh fruits and vegetables

Appropriate transport packaging technology for fresh fruits and vegetables was developed to increase the produce's marketability, and reduce handling and distribution damage from farm to market by at least 20%. Among those fruits and vegetables being studied in specific target sites include durian (Davao), queen pineapple (Bicol), solo papaya (South Cotabato), broccoli (Benguet), sweet potato (Tarlac), and okra (Nueva Ecija).

Solo papaya

A simulation trial conducted from Tupi, South Cotabato to DOST Bicutan showed that the use of corrugated box significantly reduced the handling and distribution damage on solo papaya, recorded at only 12.7%; compared to the traditional use of wooden crates with a recorded damage rate of 35.8%.

Sweet potato

Introduced packaging interventions (handling technique and suitable conveyance from farm to market), and postharvest treatment (curing and storage technique) that enhanced the quality and market potential of Philippine sweet potato; reducing damage by about 90%.

Broccoli

Initial results gathered from the simulation and field trials conducted from La Trinidad, Benguet to DOST Bicutan showed that the use of corrugated box and plastic crates reduced handling and distribution damage compared with the traditional polyethylene (PE) bags and polypropylene (PP) sacks being used by the farmers. Wrapping the broccoli with stretch film provided additional protection against compression and vibration damage.

Broccoli without wrapping

Broccoli wrapped with stretch wrap film

Temperature	Maximum shelf life	
	Wrapped	Unwrapped
1°C	25 days	8 days
15°C	6 days	3 days
room temperature	3 days	2 days

Application of **modified atmosphere packaging (MAP)** to enhance the shelf life and quality of fresh cut and semi-processed fruits and vegetables

Modified Atmosphere Packaging (MAP) technology is ideal for marketing minimally processed fruits and vegetables such as salad mixes, fruit salads and fresh produce as it is effective in maintaining freshness and increasing shelf life. Production trials on the application of MAP technology were conducted for fresh cut papaya, pineapple, pomelo, jackfruit, cabbage and mushroom. Simulation trials for these commodities were also conducted to determine the performance of primary packaging, transport box and plastic crates used.

With MAP technology, the shelf life of fresh cut fruits & vegetables stored at 5°C was extended:

Commodity	Shelf life
Papaya	from 4 to 13 days
Pineapple	from 5 to 12 days
Cabbage	from 7 to 21 days
Pomelo	from 5 to 14 days
Jackfruit	from 3 to 9 days
Mushroom	from 1 to 7 days

Different fruit and vegetable concoctions with dressings were also formulated. Based on the sensory evaluation, tropical dressing (for fruits) and tamarind-based dressing (for vegetables) were found highly acceptable in terms of taste, consistency and appearance. Samples packed in PS trays have a shelf life of 8 days at 5°C.

The technology on the use of MAP for fresh cut fruits and vegetables was disseminated through farm visits and meetings with the owners of Costales Nature Farms (Laguna) and Luntiang Republika (Cavite). In addition, a forum on MAP for vegetables was conducted in Benguet where 32 participants attended, mostly farmers, processors, academe, and other government staff.

Meanwhile, the multi-layer-high-barrier-packaging technology that keeps or retains the flavor of frozen durian has been transferred to Rosario's Farms and D' Farmer's Market in Davao City. The product was also featured in the Hong Kong Food Expo and International Food Exhibition (IFEX) 2015, Philippines where it won a Special Citation given by KATHA Awards.

Outcome 2: *Innovative, cost-effective, and appropriate technologies that enable MSMEs to develop and produce competitive products that meet world-class standards*

The Institute has also focused on boosting the competitiveness of local Micro, Small and Medium Enterprises (MSMEs). Among these initiatives were the capability upgrading of Philippine cacao, cassava, and selected fruit processing industries, and the establishment of Food Innovation Centers (FICs).

Technological support for the **upgrading of local cacao and cocoa industry**

To provide technological support for the upgrading of the country's cacao industry, gaps in the primary and secondary processing of cacao were identified and properly addressed.

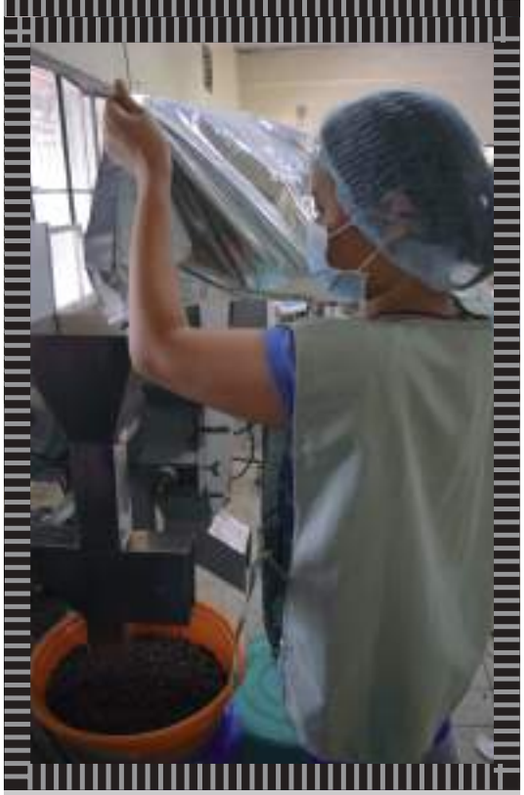
Research activities were implemented on the:

- improvement of the quality of solid cocoa liquor including molded cocoa nibs and the development of the capability of small scale processors in the manufacture of intermediate cocoa products;
- biochemical profiling for microbial augmentation and development of quality indicators for cacao fermentation and processing;
- development of quality indicators for fermented, dried and roasted cacao; and
- design and fabrication of equipment for the production of local cocoa products.

The following major gaps in the cacao industry were also addressed: the inconsistent quality of the fermented cacao beans, varying or low quality of *tablea*, and lack of appropriate processing equipment. A compilation of existing practices in primary (fermentation and drying) and secondary processing (*tablea*-making) of cacao beans in Regions 2, 5, 6, 9, 10, 11 and 12 was also produced.

In addition, field trials using different fermentation strategies in Davao and biochemical characterization of cacao beans during fermentation were conducted.

A complete production line of equipment to produce *tablea* was also designed and fabricated in cooperation with the MIRDC. The fabricated machines included the roaster, desheller/winnower, grinder, melanguer, conching machine, tempering machine, hydraulic press and the tablea molder. Likewise, a manual on the primary and secondary processing of cocoa beans was prepared incorporating the recommended practices.



Standardization of processing technology for intermediate raw materials from **cassava and its application: flakes and flour**

Intermediate raw materials from cassava for food application were developed. Cassava was processed using drum drying resulting to pre-gelatinized flakes and powder. The procedure for the production of drum-dried cassava flour was standardized and food product applications (emulsified meat, snack foods, and bakery products) were undertaken.

Processing cassava into drum-dried flour will reduce reliance on the importation of pre-gelatinized modified starches and production of pre-gelatinized flour will increase the economic value of cassava because of its many applications in food. It can be utilized as an ingredient in the formulation of baby food products and organic processed foods. Also, cassava powder can be used for gluten-free products, as a thickener or base for the preparation of instant soups, and as a binder and filler in emulsified meat products.

Cassava slices, chips, and flakes

Pilot scale standardization of product and processes using **drum drying technology** of selected materials (mango, banana and *makapuno*)

Product formulation and process for the production of drum-dried mango, banana, and *makapuno* on a pilot scale level were standardized. Drum-dried fruit flakes are shelf-stable when packed using the appropriate packaging material making them available year round. The products can be consumed as snack food or as an intermediate material to several food products.

A processing manual for drum-dried mango, banana, and *makapuno* including their product applications as intermediate material to consumer products like breakfast cereals and milk-based pastille was also prepared.

Development of **natural food coloring** from Philippine purple yam or *ube (Dioscorea alata)*

Natural colorants are now being utilized as alternatives to synthetic colorants in various food products and beverages in view of safety concerns. FPD researchers have developed processes for producing natural food coloring from Philippine purple yam (*Dioscorea alata*), locally known as *ube*. Pigments were extracted, purified, and tested in selected food products. From the crude extract, three methods to produce natural purple food colorings were developed:

- food coloring developed directly by drying the crude extract under vacuum;
- food coloring developed by purifying the crude extract and drying under vacuum; and
- with or without the addition of maltodextrin as carrier

Results of stability tests showed that the developed natural purple food colorings were stable in solutions at pH 4, 7, and 8 stored at 5^0C. The developed natural purple food colorings were unstable at elevated storage temperatures (35°C and 45°C) and upon exposure to light. The developed pure natural purple food coloring was applied in food as in sugar icing, *puto*, and merangue.

Modification of **cassava starch for various industrial applications**

The Chemicals and Energy Division or CED had succeeded in modifying cassava starch into diverse forms for various industrial applications. These are: starch acetate, cross-linked starch, heat-moisture treated starch and oxidized starch.

Starch acetate was produced by treating the native cassava starch (manufactured in Cagayan De Oro City, Philippines) with acetic anhydride. Acetylation reaction was measured by % acetyl content and degree of substitution. It showed increased thickening capacity and increased stability to chemical and mechanical stress. The product can be used in various food applications such as: dressing, mayonnaise, desserts, tinned food, frozen food, sauces, bakery products, and cake filling.

Cross-linked starch was made by cross-linking the native cassava starch in aqueous solution with a polyfunctional substituting agents like sodium trimetaphosphate (STMP) and sodium tripolyphosphate (STPP) at pH 10.5 and 45°C for one hour. It is more resistant to acid, heat, and shearing than the native starch thus, finds application in frozen food preparation and canned foods. Other applications are in the production of adhesives, paper making, and as dusting powder for surgical gloves.

Heat-moisture treated starch was prepared by a simple process that involved heating the native cassava starch with a moisture content of 18-21% at 110°C for 16 hours. This type of modified starch is used in ambient stable products, bottled sauces, sterilized soup, sauces, pies, and puddings.

Oxidized starch was processed using sodium hypochlorite as oxidizing agent heated at 50°C for 45 minutes with a pH of 9. It is widely used in food and non-food applications. The major applications are in the paper industry as a surface sizing agent and coating binder, combined with the native cassava starch in aqueous solution at pH 10.5 and 45°C for one hour.

Laboratory set-up for the production of oxidized starch

Solar-powered **lighting system**

The technical and economic feasibility of a small-scale photovoltaic (PV) off-grid system for lighting purposes was evaluated by the Chemicals and Energy Division (CED). The PV system was installed at the rooftop of CED building. The system includes 150W-solar panel, 30Amp-controller, 300W-inverter and two units of 70Amp-hours, 12V-deep cycle battery as the energy storage system. The system was able to generate electrical power for three 7W-LED light bulbs lodged at the main entrance of the building. About 80kWH energy savings was realized through the use of the PV system. These results demonstrated the system's technological appropriateness, sustainability and most importantly, its levelized cost of electricity (LCOE) and solar grid parity. This evaluation also indicates that installing the same small-scale PV system in one barangay with 100 households will save 800kWh of electricity.

The use of solar-powered lighting system can help reduce greenhouse emissions.

Prototype product of tricycle driver's roof.

Abaca Fiber as reinforcement for composite application

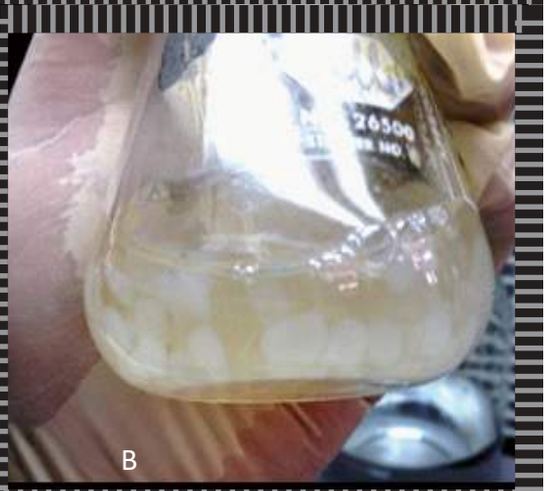
The increasing interest in environment-friendly green composite has motivated the use of degradable, renewable, and inexpensive reinforcing materials. Abaca, a natural fiber with high tensile strength, rot and salt resistance, has shown the potential as composite reinforcement. However, the hydrophilic nature of the fiber leads to incompatibility and poor wettability with hydrophobic polymer resulting to poor bonding at the fiber-matric interface. Several methods have been developed by the Materials Science Division (MSD) in a collaborative research with Korea Institute of Materials Science (KIMS) to improve the adhesion and wetting between the abaca fibers and the matrix which included surface adhesion and Vacuum-Assisted Resin Transfer Method (VARTM) for the fabrication of composite.

In June, two (2) collaborators, Gnostek Inc. and the General Santos Street Lower/Upper Bicutan Taguig Tricycle Operators-Drivers Association, Inc. (GSS-LUBTTODAI) signed a Memorandum of Agreement (MOA) with ITDI assigning Gnostek Inc. as the fabricator of abaca fiber-reinforced plastic for tricycle driver's roofs, and members of GSS-LUBTTODAI as the participants in the performance testing of the prototype products. Fifteen (15) units will be completed and deployed next year.

Cassava starch-based plastics with different local nanomaterials

Starch-based plastics are promising solutions to the worsening plastic waste disposal problems due to starch's inherent biodegradability, abundance,and renewability. Plastics made from starch alone however face major shortcomings due to high product cost and poor material properties like brittleness, poor water resistance, and weak gas barrier performance. To overcome these shortcomings and improve the material's biodegradability and compostability, modified cassava starch was processed into thermoplastic starch reinforced with nanoparticles such as nanozeolite, nanocalcium carbonate, and halloysite nanotubes.

The oxidized starch was plasticized with glycerol and other low molecular weight plasticizer using the same process used to produce conventional plastics such as polyethylene and polypropylene. This thermoplastic starch can also be blended with other polymers to suit the properties required for a particular application. Since both the oxidized starch and the nanomaterials are locally produced, production cost will also be reduced.

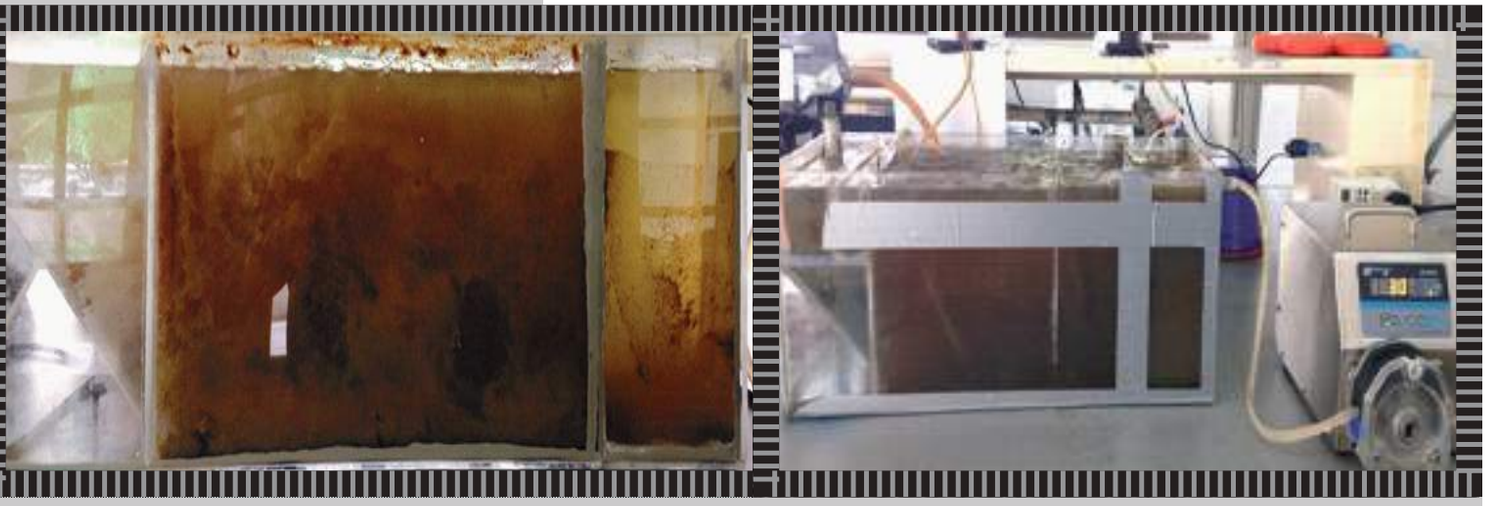


Formation of Ca-alginate beads/microspheres;
(a) Type I (2% w/w), and
(b) Type II (4% w/w)

Development of a **compact wastewater treatment system** enhanced with bio-augmentation technology for Quick Service Restaurants (QSRs)

A preliminary treatability study was conducted using the fabricated bench-scale system without carriers to determine the ability of the cultured microorganisms to treat the wastewater from the target quick service restaurant (QSR) sector. Acclimatization of the microorganisms was conducted by gradually increasing the volume of wastewater fed into the system (started at 5 liters [L]/day).

Based on the results of the experiment, the effluent chemical oxygen demand (COD) is still well below the effluent standard for COD which is at 100 mg/L. The flow rate was continuously increased from 12.9 L/day to 14.3, 15.7, 17, and 18.6 L/day at 50 revolutions per minute (rpm) pump setting, 10 loadings per day at 1-hour interval. Note that the average COD of the influent was at 1,500 mg/L, indicating the system has an efficiency of around 93-98%. This shows that the system can still handle an increase in the influent flowrate. After reaching 75% of reactor's volume capacity, pump setting was increased to 70 rpm and 90 rpm, same at 10 loadings per day at 1-hr interval. This is to simulate wastewater loading during peak hours of a certain branch. Increasing the flow would reduce the hydraulic residence time, which would in turn reduce the volume of the reactor needed for the effective treatment of the wastewater from QSRs.



Bench-scale setup for QSR wastewater treatment

Isolation of municipal solid waste inoculants and development of **small-scale composter for biodegradable waste**

Small-scale composter

In compliance with the Ecological Solid Waste Management Act of 2000 (R.A. 9003), which promotes waste segregation at source, recycling, and composting, the Environment and Biotechnology Division (EBD) developed a small-scale composter to utilize the biodegradable waste generated within DOST into useful compost product.

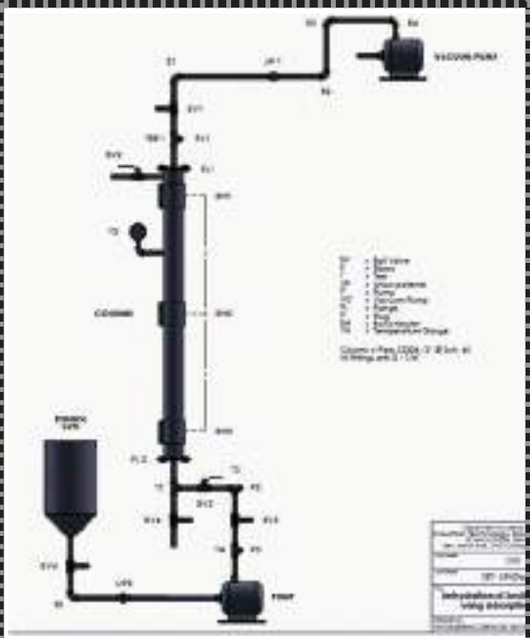
The drum-type composter is motorized with a feed capacity of 50 kilograms per batch. Feedstock consisted of biodegradable waste from DOST canteen, dried yard waste, and inoculants, that EBD microbiologists isolated from their own domestic wastes and degraded materials within DOST. Thermophilic condition was achieved during active composting.

The composter is easy to operate and maintain with no leachate production. The composter is to become part of the operations of the Materials Recovery Facility (MRF) of DOST Central Office. Waste analysis and characterization study of DOST-generated waste was initially done to determine the total amount of waste and its composition. The small-scale composter can be an alternative technology for community-based management of solid biodegradable waste.

Outcome 3

State-of-the-art facilities and capabilities that enable local industries to move up the value chain and attain global competitiveness

Researches on emerging technologies like nanotechnology and its varied application to the development of new products and treatment of industrial wastewaters have been carried out by ITDI to advance the Philippine local industries' knowledge base on science, technology, and innovation.



Dehydration set-up for purification of ethanol

Design of **purification system for fuel-grade ethanol** using nanozeolite-based molecular sieve

A purification system for ethanol was designed and fabricated by the CED. The system was made up of a nanozeolite-based molecular sieve capable of dehydrating ethanol to come-up with a 99.5% purity for use as biofuel. Molecular sieve technology offers various advantages for ethanol dehydration which include simplicity in processing ethanol and ethanol-containing contaminants, longer service life span of the dessicant material, and configurability of the system as stand-alone or as integral part of the distillation system.

Design of **carbon dioxide (CO_2) capture system** utilizing molecular sieve membrane technology for combustion systems

The CED also designed and fabricated a CO_2 capture system made up of nanozeolite-based molecular sieve membrane. The system is intended for capturing CO_2 from post-combustion emissions. It was tested in a fluidized bed combustion sytem and diesel-fired boiler; capturing a significant amount of CO_2 which was about 15.0-18.5%.

Fluidized bed combustion system with CO_2 capture system

UV irradiation of PLA/starch composites

Treatment for 10 L contaminated wastewater from modified starch processing

Nanocomposite pellets with NPCC

Nanocomposite packaging film with NPCC

Modified starch processing for **biological treatment of industrial wastewater**

EBD researchers used aerobic and anaerobic microbial pathways to treat industrial wastewater focusing on modified starch processing. Wastewater produced by these industries contains high levels of contaminants that pollute the waterways. Proper treatment is needed to achieve the standard effluent limit before discharging into the waste stream. Biological treatments are also considered as more natural processes and cheaper in capital investment and operating cost compared to physical and chemical treatments.

Organic and inorganic impurities from modified starch processing were removed through the action of locally-isolated bacterial strains under aerobic conditions in bioreactors. The bacterial inoculum-treated wastewater effluent was re-circulated in the bioreactor for the gradual removal of these impurities. Bacterial isolates were optimized in 0.8% nutrient broth for 24 hours at room temperature and pH 6.0 in an environmental shaker at 150 rpm (revolutions per minute). Significant reduction in the chemical oxygen demand (COD) in each modified starch process was observed as follows: 97.10% (heat-moisture treated), 96.22% (alkalinization/cross-linked), 73.72% (oxidation), and 64.60% (acetylation).

Utilization of local nano-precipitated calcium carbonate **(NPCC) in nanocomposite packaging films**

Studies on the application of locally produced NPCC as reinforcing additive in thermoplastics such as polyvinyl chloride (PVC), polypropylene (PP) and polyethylene (PE) are on-going. NPCC may be used to partially replace the existing elastomeric reinforcing additives in thermoplastics. Unlike the normal micron-sized additives which have a detrimental effect on the impact strength of the polymers, the use of NPCC could be a good alternative or replacement. Nano-sized filler/reinforcement as additives in thermoplastics allows lower filler loading while achieving the desired properties compared with the existing reinforcement additives used by the industry. Developing reinforced thermoplastics with lower cost and enhanced properties will help support the growing plastic industry.

MSD researchers are now investigating the application of local NPCC in nanocomposite packaging films. Initial results showed an increase in the mechanical properties and an improvement in the processibility of the packaging films.

Raw Limestone from Negros Oriental

Nano-precipitated calcium carbonate (NPCC)

Local production of **nano-precipitated calcium carbonate**

Calcium carbonate (CaCO3) in limestone deposits can be recovered in two grades that are currently used: ground calcium carbonate (GCC) and precipitated calcium carbonate (PCC). Precipitated calcium carbonate (PCC) has received significant attention due to its wide applications in the areas of papermaking, rubber, plastics, paints, pharmacy, agriculture, and food. Further processing to nano-precipitated calcium carbonate (NPCC) renders it with unique properties for these applications. K&E Industrial Lime with vast deposit of limestone in Negros Oriental collaborated with DOST-ITDI through a PCIEERD-funded project for the development and production of nano-precipitated calcium carbonate from local limestone. To date, processing parameters/conditions have been optimized for the synthesis of NPCC having an average particle size of 50-60 nm. Bench scale production and industrial application of NPCC is being undertaken.

Raw zeolite from Pangasinan

Nano zeolite pellets

Synthesis and industrial application of **nanozeolite**

Zeolites are naturally occurring nanomaterials that have crystalline porous alumino silicate minerals and are abundant in Pangasinan. They have widespread industrial applications such as as selective adsorbents, molecular sieve, ion exchangers and catalysts. In agriculture, zeolites are used as soil conditioner, feeds, odor adsorber in aquarium and cat litter. However, their use is limited due to variations in chemical composition, properties and impurities.

Through chemical modification, MSD researchers has improved the quality of local zeolites providing a more cost effective alternative nanomaterial for a wider range of industrial apllications other than agriculture, as in mining, polymer and plastic, chemical, and environment.

The physico-chemical characteristics of synthesized nanozeolite showed an average particle size of 70-60 nm. There was an increase in the cation exchange capacity of the nanozeolite compared to the natural zeolite ranging from 190-200 cmol/kg. Performance testing of the synthesized nanozeolite for several industrial applications such as as packaging films, water filters, material for oil spill was also conducted.

South East Asian atmospheric corrosion exposure study of electronic equipment and components under a marine environment in the Philippines

A three-year joint research on atmospheric corrosion studies between MSD and Japan's National Institute of Materials Science (NIMS), the project will assess the corrosion resistance properties of electronic equipment, installation kits and components, and steel test panels exposed to corrosion in a marine environment at the compound of Asian Chemical Corporation, Phoenix Industrial Park Corporation (PIPC) in Calaca, Batangas.

The corrosion behavior of electronic parts/ components in terms of rate in mil/year will be investigated while the corrosion products formed on the metal samples over a substantial period of natural exposure will also be characterized. Characterization of corrosion products and understanding how they are formed are important factors for the development and improvement of materials corrosion resistance.

The exposure site is equipped with the necessary monitoring gadgets (e.g., RH/T Sensor; atmospheric corrosion monitor or ACM; multi-channel data logger). Actual exposure of samples commenced on June 23, 2015 and researchers conducted monthly exposure site visits, on-site inspection of samples, and actual retrieval of atmospheric and ACM data.

NIMS-Japan will also conduct the same study through its Materials Reliability Unit exposing the same batch of samples at its marine exposure site in Miyakojima Island, Japan.

Installation of electronics equipment, installation kits and steel test panels, monitoring gadgets (temp/RH sensor, data logger, ACM sensor, and power supply), and labeling at the Marine Exposure site in Asian Chemical Corporation, Calaca, Batangas

Surface modified zeolite for **oil sheen decontamination**

Preliminary experiments to develop a cost-effective adsorbent from modified zeolite for the removal of oil and grease in a simulated contaminated wastewater was conducted by the EBD. Surface modification of locally mined zeolite using hexadecyltrimethyl ammonium bromide (HDTMA-Br) significantly enhanced the property of the resulting adsorbent in removing oil and grease from aqueous solution. Thus, field testing of the developed adsorbent material with simulated wastewater spiked with either gasoline or diesel was done to validate the results of the previous experiments.

Surface modification was done for five kilograms of local zeolite mined from Mangatarem, Pangasinan. Batch adsorption tests with corresponding amount of surface-modified zeolite resulted in remarkable diesel removal efficiencies of 98.9% (1 g), 99.7% (5 g) and 99.9 % (10 g) in simulated wastewater containing 5,000 ppm of diesel. It was also studied using a semi-continuous lab-scale column with high average removal rates in the range of 88%-100% after passing 43.2 L of 5,000 ppm diesel-contaminated wastewater. Validation of the results involved the fabrication and leak testing of a 5-L PVC column equipped with clear window to determine both breakthrough and exhaustion points using pelletized modified zeolite. Column testing using simulated wastewater spiked with 2,000 ppm of diesel is currently conducted. Around 50 samples were collected on an hourly basis and were submitted for oil and grease analysis.

Surface-modified zeolite

Column testing of surface-modified zeolite using diesel-contaminated wastewater

Pilot-scale treatment of distillery and meat processing wastewater using **Anaerobic Sequencing Batch Reactor (ASBR)**

A pilot-scale treatment of distillery and meat processing wastewater using the anaerobic sequencing batch reactor (ASBR) was carried out in 1000-L capacity digester fitted with 125-L drum-type gasholder. Inoculum acclimatization was done using distillery and meat processing wastewater as substrates and introduced to the ASBR system. The ASBR operations consisted of the following phases per cycle: filling, reaction, settling and decanting. Effluent's chemical oxygen demand (COD) and biological oxygen demand (BOD) levels were reduced with significant reductions as well in total suspended solids (TSS), turbidity, and effluent color. Biogas produced during the anaerobic treatment can be used as an alternative fuel (i.e. biofuel, cooking applications) and the sludge by-product as soil enhancer.

Anaerobic Sequencing Batch Reactor (ASBR) set-up

technicalservices

Table 1. Total number of technical services rendered

Technical Services Area	NCR	CAR	I	II	III	IV-A	IV-B	V	VI	VII	VIII	XVIII	IX	X	XI	XII	XIII	AR MM	TOTAL PHIL.
Food Processing	62	1	4	1	12	22	8	2	8		1	1					3		125
Food Safety	71				1	5				2					1		3		83
Disaster Relief Foods	1				1														2
Calibration / Measurements	6507	44	1714	2183	552	672	120	139	110	100	83		50	41	87	19	10		12432
Packaging Technology	80	1	7	1	10	27	2	2	3		23	2	2	2	2				164
Health and Wellness	191	1	15	2	10	60	2	2	3	1			1			2			290
Materials Processing	107			1	5	61		2	1	1		3		3					184
Waste Management			1			2	1		1					1					6
Environment Technology Verification (ETV)	9																		9
Energy Efficiency	6				1	6			1						1				15
Gift, Decors & Housewares	1																		1
NANO TECH	4					1													5
Testing and Analysis	2772	43	296	99	173	693	68	283	57	13	2	3	13	19	19	32	3		4588
TOTAL	**9811**	**90**	**2037**	**2287**	**765**	**1549**	**201**	**430**	**184**	**117**	**109**	**9**	**66**	**66**	**110**	**53**	**19**	**0**	**17904**

The Institute continues to provide technical services in various forms and areas as in metrology, tests and analyses, technical assistance/supervision, technology needs assessment, and consultancy and management; all aimed at improving overall productivity of stakeholders/clients.

In 2015, a total of 17,904 technical services covering various disciplines were rendered to about 5,541 recipients around the country, generating an income of PhP 33,063,391.34 summarized as follows:

Calibration and Measurement	- PhP 11,507,292.20
Clearance and Certification of fees	- PhP 1,177,580.00
Testing and Analysis	- PhP 13,014,403.58
Miscellaneous Income	- PhP 2,033,860.00
Other Specialized Services	- PhP 5,330,255.56

Tables 1 and 2 tabulate the service areas covered and the number of recipients per region, nationwide.

Table 2. Total number of clients served

Technical Services Area	NCR	CAR	I	II	III	IV-A	IV-B	V	VI	VII	VIII	XVIII	IX	X	XI	XII	XIII	AR MM	TOTAL PHIL.
Food Processing	163	1	45	1	241	131	171	2	198		48	7			4		31		1051
Food Safety	58				25	5				42					1				131
Disaster Relief Foods	18				16														34
Calibration / Measurements	789	5	22	2183	297	376	18	20	10	15	8	6	7	7	9	5	5	1	1612
Packaging Technology	89	33	7	1	10	27	2	2	4		23	6	2	2	2				210
Health and Wellness	200	32	15	2	23	235	21	2	49	34	56		13			59			769
Materials Processing	107			1	5	61		2	1	1		3		3					184
Waste Management	9		43			32	6		20		38			19			21	1	189
Environment Technology Verification (ETV)	9																		9
Energy Efficiency	37	1		1	1	6		2	45							23			116
Gift, Decors & Housewares	1																		1
NANO TECH	4					1													5
Testing and Analysis	656	7	63	13	48	268	29	90	22	3	2		1	4	8	12	4		1230
TOTAL	**2140**	**79**	**195**	**67**	**666**	**1142**	**247**	**120**	**349**	**95**	**175**	**22**	**23**	**35**	**24**	**99**	**61**	**2**	**5541**

standards & testing

Production of secondary reference materials and provision of proficiency testing for metals in water

Conducted by the Standards and Testing Division (STD), the project aims to develop local capability and expertise in the production of secondary reference materials and to conduct Proficiency Testing (PT) for metals in water. This will become an integral function of ITDI and serve as a major link for the implementation of metrology in chemistry in our country. Most important in achieving accurate and reliable test results is the use of accurate standards or certified reference materials (CRM) which ensures traceability of analytical data to primary international standards warranting the Quality Assurance and Control (QA/QC) of the laboratory. About 50 chemical testing laboratories are accredited by the Philippine Accreditation Bureau (PAB) to ISO 17025. Quite a number of laboratories are still not accredited since they cannot afford the high cost of CRMs and PTs which are usually sourced from foreign countries which can be addressed through this project.

Through this project, STD participated in key comparison studies conducted by the Asia Pacific Metrology Program (APMP) and Consultative Committee on Quantity of Matter (CCQM) to demonstrate its technical competence. It analyzed and calculated data for Arsenic, Cadmium, Iron, Lead and Manganese in contaminated and non-contaminated soils as part of the CCQM Key Comparison conducted by Centro Nacional de Metrologia (CENAM) of Mexico and Institut Josef Stefan (JSI) of Slovenia.

Since the start of the project in 2012 four PT schemes for metals in water (Lead, Cadmium, Copper, Iron, Magnesium, Nickel, Cobalt, Zinc, Manganese and Calcium) were conducted with more than 30 government and private laboratory participants.

Proficiency Testing (PT) samples for trace metals and calcium in water

Analysis of trace metals in PT samples using Flame Atomic Absorption Spectrophotometer

PT sample on benzoic acid in juice

PT sample on histamine in canned tuna

Inter-laboratory comparison of additives and contaminants in foods

The project entails inter-laboratory comparisons through proficiency testing (PT) schemes on the analysis of additives and contaminants in foods. Method development and validation of the gravimetric method for the chosen analyte were performed using HPLC analysis. The PT materials were distributed after acceptable results for homogeneity and stability tests were established.

The reference value for the first PT scheme on benzoic acid organized by STD was assigned by the Health and Services Authority (HSA), Singapore using a higher order method like ID-GCMSMS. In the next PT schemes for benzoic acid and histamine, the assigned values were already provided by STD using isotope dilution technique coupled with Liquid Chromatography-Mass Spectrometry (ID-LCMSMS). Traceability of the measurement of the reference/assigned values was established through the use of certified reference materials (CRMs), calibrated microbalance and analytical balances, and using a higher order method like ID-GCMSMS and ID-LCMSMS.

Reference materials were also developed and PT schemes for benzoic acid in mango juice and histamine in canned tuna were carried out. Likewise, STD participated in the Asia Pacific Metrology Program (APMP) key comparison for benzoic acid. Highly accurate and traceable measurements for the said analytes are then disseminated to the testing laboratories through the PT schemes.

Analysis of samples using Liquid Chromatography Tandem Mass Spectrometry (LCMSMS)

Integration of testing services for rubber and rubber-based products

The project aims to enhance the capability of the STD to offer complete laboratory testing services for manufactured rubber-based products to meet industry requirements. The demand for testing services for rubber products come from clients from the DPWH, NAIA, DOTC (MRT-LRT), MWSS, importers-distributors of rubber products, and the Philippine Rubber Industries Association (PRIA), an association of manufacturers and traders of rubber products, raw materials, and supplies.

Through this project, the Philippines will be able to comply with the standards being adopted by the ASEAN community in preparation for the harmonization of standards. The quality of rubber products produced by the local manufactures can be determined and improved, and foreign investors are assured that the local products conform to the International Standard, and this development may result to increased investments in the local rubber industry.

To step up their expertise in the field, the project team conducted study visits to the following: Malaysian Rubber Board, New Pro Ind. Corp., the rubber testing laboratory at DOST IX, and the Rubber Plantation and Processor in the Philippine Pioneer Rubber Product Corporation, in Zamboanga City. In addition, the STD testing services for rubber were promoted in the 2nd Philippine Rubber Investment and Market Encounter (PRIME) in Davao City last November.

Testing equipment for rubber

Testing of rubber product using ozone chamber

advanced device and materials testing laboratory

Expanding the role of advanced testing laboratories in the Philippines

In support of the Semiconductor and Electronics Industry (S&E) sector which is considered as one of the leading and important industries that contribute to the country's export earnings, the Advanced Device and Materials Testing Laboratory (ADMATEL) was established. To date, multinational S&E manufacturers are already availing of the ADMATEL's services.

The presence of a high-level testing facility has enabled the sector to solve ageing failure analysis (FA) problems and aided them in new product development, design development verification, and new designs and technologies validation. This has opened localization of design and corrective actions and has provided easy access on state-of-the-art laboratory service resulting to savings in terms of reduced machine downtime and the risk of damaging "golden" sample brought about by shipment.

Furthermore, ADMATEL plays an integral role in building electronics product development capability in the country. For instance, an integrated circuit (IC) designed by the Philippine Institute of Integrated Circuits (PIIC) or a prototype made at the Electronics Product Development Center (EPDC) can be tested in ADMATEL using state-of-the-art facilities.

Recently, ADMATEL is enrolled in the One Stop Shop Laboratory Services (One Lab), the analytical and calibration testing system's innovation of the Department of Science and Technology (DOST) in collaboration with private and government testing laboratories as well as foreign-based ones.

PAO Accredited Testing Laboratory
PNS ISO/IEC 17025:2005
LA-2015-272A

national metrology laboratory of the philippines

Five-year ISO/IEC 17025 re-accreditation

The National Metrology Laboratory of the Philippines (NML) has been granted re-accreditation for another five years until year 2020 by the Deutsche Akkreditierungsstelle (DAkkS), the national accreditation body of the Federal Republic of Germany to perform calibrations in the field of mass, temperature, pressure and electricity in accordance with the standard ISO/IEC 17025:2005.

The NML is the first and only laboratory in the Philippines accredited by DAkkS to competently carry out calibrations of mechanical, electrical, and thermodynamic quantities since 2010.

New this year are the calibrations of non-automatic electronic weighing instruments, pressure measuring equipment for absolute pressure, and time base of frequency counters and generators.

The accreditation activity was carried out within the framework of the bilateral project “Strengthening of the National Quality Infrastructure in the Philippines” with the German Federal Ministry for Economic Cooperation and Development.

The globally recognized measurement services of NML provide the gateway for the international traceability of measurements in the Philippines, enabling the local industries, private and government calibration laboratories, and testing laboratories among others, to avail of the services at a lower cost than if they seek such overseas.

The mutual recognition of DAkkS in the European Cooperation for Accreditation and the International Laboratory Accreditation Cooperation, ILAC ensures the acceptance of NML’s calibration certificates in all member economies worldwide.

A database of all accredited bodies is provided by DAkkS on its website www.dakks.de

ilac-MRA

DAkkS
Deutsche
Akkreditierungsstelle
D-K-15035-01-00

Internationally accepted CMC in thermometry

New Calibration and Measurement Capabilities or CMC of the country through the National Metrology Laboratory of the Philippines in the field of Thermometry was recently approved and published in the International Bureau of Weights and Measures (BIPM) Key Comparison Database (KCDB) on November 2015.

The Philippines now has registered CMCs covering the measurement fields of Thermometry and Mass, with CMCs in Mass previously published in the database in December 2013.

The publication of CMC in the database means that the country's metrological competence is recognized by peer National Metrology Institutes (NMI) all over the world. It further means the acceptance of the calibration certificates issued by that NMI in 98 institutes worldwide and 153 designated institutes participating in the International Committee for Weights and Measures (CIPM) Mutual Recognition Arrangement. Internationally recognized metrological competence in a country is fundamental to guarantee reliable testing and analyses, and lays the foundation for international acceptance of the results.

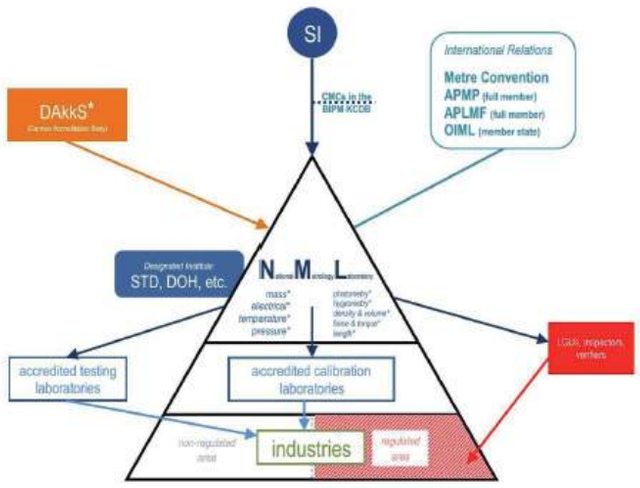
The approval of CMC is based on three essential elements: participation in reviewed and approved scientific comparisons; operation of an appropriate and approved quality management system; and international peer-review both intra and inter-regional of claimed CMCs.

Once approved, it is then published in a single, world-wide publicly available database (http://kcdb.bipm.org) accessible to everyone.

View CMC of the Philippines:
http://kcdb.bipm.org/appendixC/T/PH/T_PH.pdf
http://kcdb.bipm.org/appendixC/M/PH/M_PH.pdf

Proposed strategy for the National Metrology Infrastructure of the Philippines

The National Metrology Laboratory of the Philippines has prepared a document describing the proposed national metrology strategy in support of the national government's economic plan to "achieve competitiveness in the national and international markets" and to safeguard its people and the environment.



Target Philippine Metrology Infrastructure

The proposed strategy was intended to serve as a guide to government decision makers and to the National Metrology Laboratory to ensure the development of a well-functioning national metrological infrastructure that fulfills the need for reliable and accurate measurements in the country and in harmony with international standards and best practices.

In crafting this strategy, NML considered the experiences of neighbouring ASEAN national metrology institutes and the huge investments poured in by their governments for the development of their own national metrology institutes in support of trade, innovation, health, and safety.

The document can be viewed and downloaded at www.nml.gov.ph

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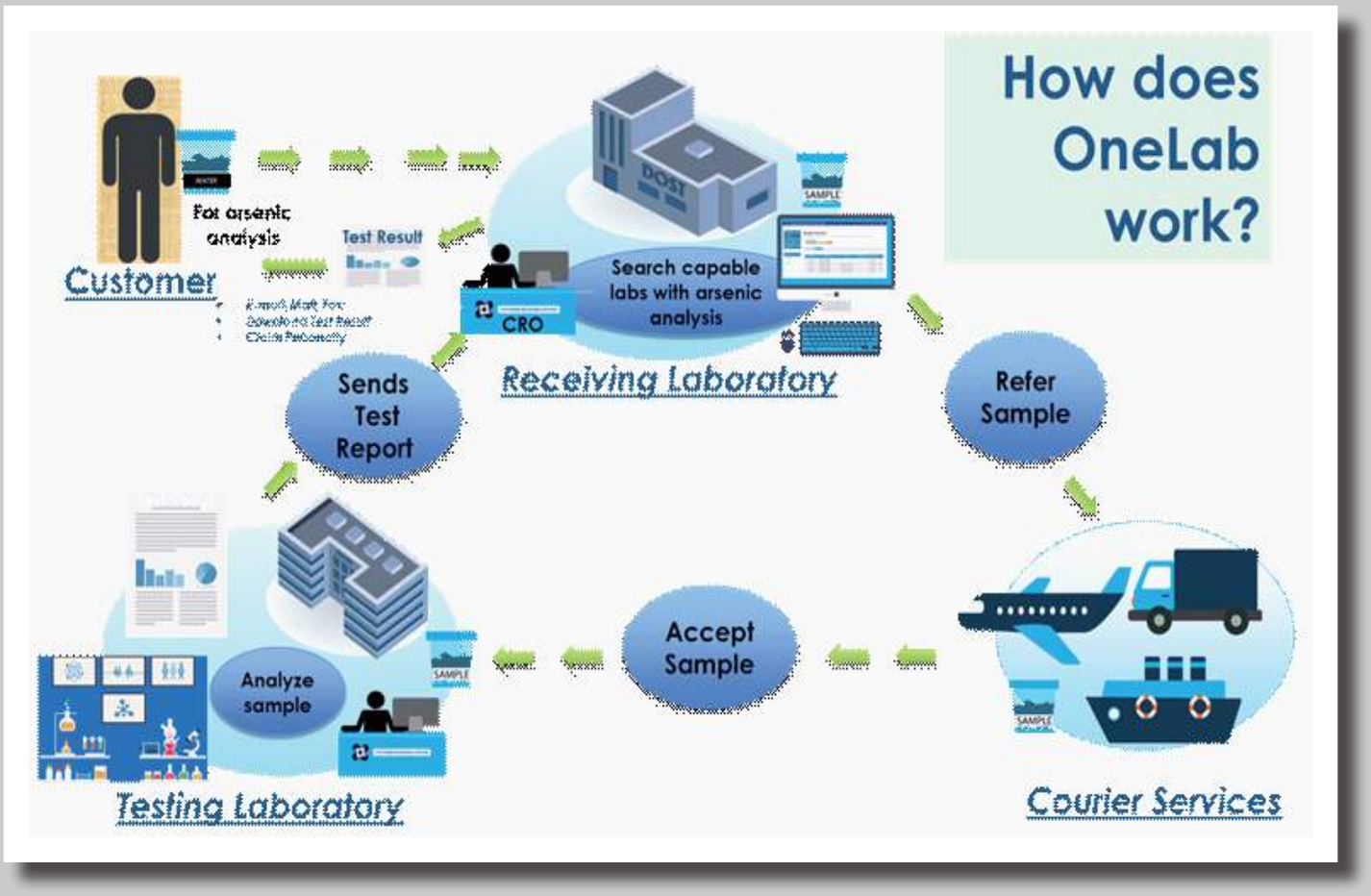
One Laboratory. Nat



ionwide

The One-stop Laboratory Services for Global Competitiveness (OneLab) project is an IT-based solution to broaden public access to testing services of laboratories in the Philippines at a single touch point. OneLab's backbone is an IT system composed of six (6) components: Sample Management, Resource Management, Customer Portal, Equipment and Supply Inventory, Web Services and Data Management. It has a complete database of all the testing services and capabilities of DOST laboratories, including the cost of each test. Utilizing the in-house-developed information system, customers are provided with accurate and complete instructions regarding the testing requirements as well as on-line access to track the status of their test requests. The project is co-managed by ITDI and DOST IX with the active participation of PNRI, FPRDI, MIRDC, PTRI, FNRI and 15 RSTLs (Regional Science and Technology Laboratories). ASTI lends technical support in the system development namely, the Unified Laboratory Information Management System (ULIMS) and the Referral System. The project is funded by DOST and monitored by PCIEERD.

Now on its Phase 2-Y1 of implementation, OneLab integrates DOST and other government and private laboratories in a single platform to facilitate wider access for testing and calibration needs of the MSMEs, the manufacturing industry, exporters and importers nationwide. The 1st batch of non-DOST laboratories participating in the network includes: Fertilizer and Pesticides Authority (FPA); DOH-National Reference Laboratory; University of the Philippines-Manila (UPM)-NIH; DOH-Food and Drug Administration (FDA); Philippine Institute of Pure and Applied Chemistry (PIPAC); SGS Philippines Inc., and F.A.S.T. Laboratories.

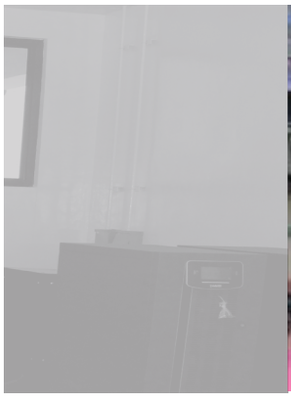
The signing of the Memorandum of Understanding (MOU) between DOST and the Fertilizer and Pesticides Authority (FPA), Food and Drug Administration (FDA), National Institute of Health (NIH), National Reference Laboratory (NRL), SGS Philippines Inc., F.A.S.T. Laboratory, Philippine Institute of Pure and Applied Chemistry (PIPAC) during the opening of the NSTW (July 24, 2015) at SMX, Mall of Asia in Pasay City.

ITDI hosts First Philippine NanoDay

ITDI hosted the First Philippine NanoDay at the DOST-ITDI Nanolab as part of the celebration of ITDI's 114th Foundation Anniversary with the theme, "Nanotechnology for Every Juan" on July 01-02, 2015. The event featured the following activities: showcase/exhibits of new nanotechnology products and equipment for nano products/ materials characterization; technical seminars; state of the art equipment workshop; and tour of DOST-ITDI Nanolab and ADMATEL (Advanced Device and Materials Testing Laboratory) research and laboratory testing facilities.

More than 400 participants from the industry, academe, research institutes, and other DOST agencies participated in the event. Nano Day also featured an activity for children dubbed as "Nanokid's Day" to emphasize that nanotechnology is indeed for every Juan.

The nanotechnology seminars were held at the DOST Executive Lounge to accommodate the large number of participants. During the first day, seven local and international experts talked on nanotechnology characterization techniques while on the second day, six experts from the industry shared their experiences on the industrial applications of nanotechnology.



Former Balik Scientist and Professor of the Case Western Reserve University, Ohio, USA, Dr. Rigoberto Advincula, was among the list of distinguished speakers which included chief officers of high level companies (e.g., Beta Nanocoating, Pacific Paint (Boysen) Philippines, JEOL Asia, Shimadzu, Petron, Bruker Singapore). Actual demonstrations/ workshops on the various equipment at the Nanolab and ADMATEL were also conducted.

Participating industry and academe also showcased their latest products and equipment during the exhibit. Among them were UP Los Baños-Nanotech Laboratory, Pacific Paint (Boysen) Philippines, Inc DKSH Technology Philippines, Inc., Katrin Field Incorporated, Sigmatech, Philab Industries, Inc., Shimadzu Philippines Corp., ArrowFil, NTEKSYSTEMS Inc., and Elitech Trading Corporation.

This first ever NanoDay resulted to a forging of nanotechnology-related research collaborations between UPLB Nanotech and MSD-ITDI.

technology transfer and commercialization

As the Institute's arm for technology transfer and commercialization, the Technological Services Division or TSD facilitates the provision of technical services and eventual transfer of technologies leading to commercialization by implementing projects or initiatives in various forms and channels.

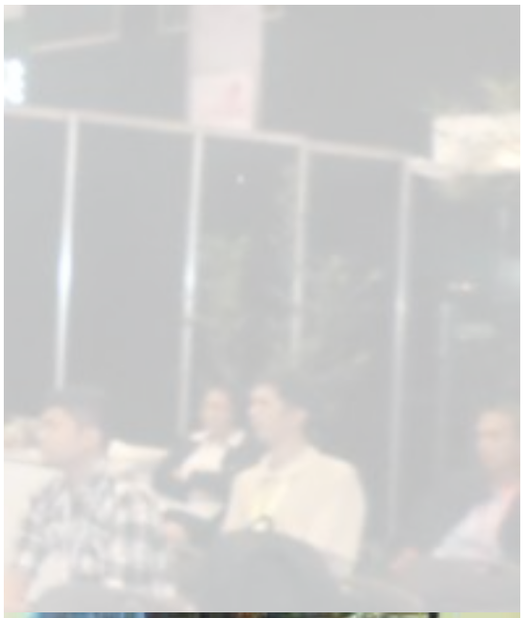
Likewise, the TSD continue to provide support to R&D in the form of CADD design, fabrication, installation, machining, mechanical, and patent drawing.

Training, technical assistance & consultancy

Different types of business portfolios were developed to facilitate the conduct of technical services and/or transfer and eventual commercialization of technologies. For the year, 16 business opportunity plans or BOPs of technologies on food (e.g., banana/ *macapuno*/mango flakes from puree, bottled sardines in oil, *Tapuy* using ITDI *bubod*); health and wellness (e.g., ceramic water filter, citronella oil, dietary health supplement from *malunggay, duhat* and banana, soaps); and Emergency Food Reserve (EFR) were prepared.

Likewise, 12 market studies were prepared covering technologies as alternative sugar from nipa sap/pineapple sap, ceramic water filter, coffee roasting machine, dietary supplements, solar biomass for multi-heating application, and water retort, among others.

A total of 25 Memoranda of Agreement (MOA) for techno-transfer were processed with an expected income generation of PhP 2,018,578.00 for the Institute.



In joint efforts with concerned R&D divisions, a total of 102 trainings were facilitated and conducted with 2,101 participants coming from MSMEs, LGUs, cooperative/association, academe/SUCs, government offices, and NGOs from around the country. A total income of PhP 617,858.23 was generated from these trainings.

The training courses covered different areas among which include: calibration of equipment for industries to equip technical staff/ laboratory analysts and managers with basic knowledge and skills in calibrating various laboratory equipment like electronic balances, volumetric wares, digital multimeters, pressure measurements and pressure gauge; food (veggie-based bakery production with GMP, post-harvest processing and preservation of fruits and vegetable and EFR processing, fish processing, mushroom production, ready-to-drink juice, meat processing, mango processing, integrated fruit and vegetable processing, and awareness seminar on food packaging and label design); personal care products (hand and body lotion, shampoo, perfume, and body scrubs; soapmaking, and herbal processing); solid waste management (operation/installation of styro plastic densifier, bioreactor, and biogas technology for LGUs); and energy audit analysis.

Aside from these, an international training funded by the DFA-TCCP was also facilitated that was conducted by ITDI food experts.

Technical services rendered during the year covered various areas. Technical assistance provided nationwide during the year dealt mostly on: installation, operation and maintenance of bioreactor, styro plastic densifier, vinegar acetator; production of ceramic water filter/ establishment of facility; biomass-fired steam kettle for coconut water processing; and establishment of *muscovado* processing facility.

Technology adopters

In 2015, 12 technologies were adopted in 11 regions of the country as tabulated in Table 3. Meanwhile, coordination and preparation of the Technology Licensing Agreement (TLA) between ITDI and Community Health Education Emergency Rescue Services (CHEERS) Corp. for the adoption of EFR or Emergency Food Reserve is underway.

Table 3. Technologies tranferred to beneficiaries by region

Region	Technology
NCR	1 Shelf stable RTE chicken *arroz caldo* as relief food 2 Shelf stable sautéed shrimp paste 3 Acetator kit 4 Bioreactor (3) 5 Emergency Food Reserve (EFR)
I	1 Bioreactor 2. Styro plastic densifier
II	1 LPG fired kiln 2 Acetator kit
CAR	LPG fired kiln
IV	Bioreactor
IVB	Ceramic water filter
V	Gasifier combustor (2)
VI	Acetator kit (4)
CARAGA	Bioreactor
X	Commercial production of pectin from calamansi waste
XI	1 Multi-layer high barrier packaging technology for frozen durian 2 Transport packaging technology for fresh durian 3 Acetator Kit (2)

Technology roll out

DOST-developed food processing equipment in Food Innovation Centers (FICs)

The TSD along with the FPD, MIRDC, and DOST-PMEDSO spearheads the roll out of DOST-developed food processing equipment to the regions towards the establishment of FICs or Food Innovation Centers nationwide as support to MSMEs, to help them move up the value chain and boost their productivity towards global competitiveness. The FICs shall serve as hub for food product development and innovation in the regions nationwide, where concepts can be transformed into tangible products.

During the year, food process equipment (e.g., vacuum sealer, vacuum fryer, spray dryer) were deployed to three more FICs which are now operational: 1) NCR, UP Diliman; 2) Region VI, Western Visayas, Guimaras State University, Mosqueda Campus; and 3) Region X, Northern Mindanao, Mindanao University of Science and Technology. With the other three existing FICs since last year, a total of six FICs have already been established. A freeze dryer was also deployed to DOST XI.

To equip the FIC staff, operators, and managers, a trainer's training on food processing/preservation and operations of the DOST-developed food processing equipment was also conducted in Tacloban City, Leyte with 31 participants; and another one held in ITDI-DOST, Bicutan, Taguig City with 42 participants from DOST Regional Offices II, IV-A, IV-B, VI, VIII, IX, X, XI and NCR.



Ceramic water filter

The establishment of production centers for ceramic water filters in various regions is also underway. Through site assessment, supervision of construction and installation of LPG-fired ceramic kiln, and trainings, among others; three more ceramic water filter production plants were established in 2015, namely: (1) CAR (LGU-Bauko, Mt. Province); (2) University of Northern Philippines (UNP) Vigan, Ilocos Sur, Region I; and (3) LGU-Sta. Maria, Isabela, Region II.

Aside from the above-cited, already existing ceramic water filter plants in Regions III (Eliano Baluyut Pottery, Inc., Pampanga), and IV-B (Gabisan Pottery Plant, Torrijos, Marinduque) were also assisted.

Likewise, various forms of technical assistance (e.g., site assessment, mold making, and requirements on the establishment of production facility) were provided to prospective adopters in other regions such as DOST-V [Magarao Ceramic Producer Association (MACEPRA), Naga, Camarines Sur]; VIII (LGU-Tanauan, Leyte); and X (DARS Ceramics, Bulua, Cagayan de Oro City).

Currently, three established production centers in Pampanga (Eliano Baluyut Pottery, Inc.), Vigan, Ilocos Sur (University of Northern Philippines (UNP)), and Sta. Maria, Isabela (LGU) are now mass producing ceramic water filters for sale.

Both roll out projects are being funded by PCIEERD.

Demo/hands-on during the training conducted for LGU-Bauko, Mt. Province

Ribbon cutting led by Sec. Montejo and DOST-2 Regional Director Dr. Tejada during the inauguration program for the Established Production Center for CWF in Sta. Maria, Isabela.

Communication collaterals/media and campaigns

The TSD develops and produces various forms of communication collaterals/IEC materials in support of its technology transfer and commercialization function. These are used to communicate ITDI's technologies and services and serve as gateway for stakeholder engagement along with other forms of campaigns and channels.

In 2015, different types of communication collaterals were produced and released which include: one Annual Report 2014, one issue of Techno Bulletin, nine issues of MiscellaNews, 12 issues of Flash News, 13 technology flyers; one corporate brochure and a mini journal as collaterals for the SIAL-ASEAN (FIC) 2015 exhibit for corporate image building. About 3,000 copies of these various collaterals were distributed to ITDI stakeholders in different events.

Editing services were also provided and about 14 speeches and messages for DOST and ITDI officials were prepared. About 60 desktop publishing requests were also served.

Press and media relations initiatives were likewise pursued to help drum up attention on the Institute and its technologies and services among which include: three feature articles, 25 press releases, 3 TV interviews, 2 press conferences, and 16 radio interviews. A total of 71 ITDI releases were monitored/retrieved, online and print.

In January, the TSD launched its face book page which has been renamed as ITDI-DOST Updates. Technology videos were uploaded initially for public access and the page continuously undergoes periodic updating with uploading of new information as they arise.

ITDI also hosted the first leg of DOST-STII's Science Nation Tour dubbed 'Agham na Ramdam' showcasing the ADMATEL; and was also among the major players in its finale, the DOST-NCR 2015 Science Nation Celebration in December; and participated in the Guided Open House/ Agency tours and Amazing Science Race.

Likewise, the TSD facilitated ITDI's active participation in the NSTW 2015 media blitz aimed to increase participation to the NSTW 2015 celebrations which included attendance to press conferences and radio interviews with press briefs and interview guides and materials prepared for ITDI officials/guests; and submission of top five stories and press releases. ITDI activities before the NSTW opening were also counted in as DOST pre-events where invites were distributed to guests to beef up attendance to the main event.

Around 150 inquiries (from walk-in clients and phone inquiries) for technical information on various technologies of ITDI were attended to while 15 study tours to ITDI labs and facilities were accommodated. Visitors (about 300) came from schools/ universities, LGUs, Congress, other government agencies, and one foreign delegation from Vietnam.

Exhibits

ITDI participated in 19 exhibits foremost of which was the 2015 National Science and Technology Week (NSTW) which carried the theme, "Science Nation" Philippines: A Science Nation Innovating for Global Competitiveness", held at the SMX Convention Center on July 24-28. The Institute's technical services and researches were among the showcase in Outcomes 2, 3, 6, and 8. Selected features from the national showcase were then brought to the four cluster fairs held in: Palawan (South Luzon), Vigan (North Luzon), Ormoc (Visayas), and Zamboanga (Mindanao).

In addition, nine invitations from academe and other agencies were also accommodated (e.g., ASEAN EU STI Days, Paris, France through TAPI; TESDA "Green Technology Exhibit", UP CAPS-Career Assistance Program from Scientists Career Fair).

Also during the year, the TSD, with funding from TAPI, initiated showcasing the DOST-developed food process equipment at SIAL ASEAN 2015 in June at the World Trade Center Metro Manila (WTCMM).

SIAL (Salon International de l'Agroalimentaire) is the biggest and largest food exposition in the world, gathering exhibitors from around the world to meet local and regional buyers. It provides the industry players a global platform in a business-to-business environment. With the food giants from all over the world gathered in this one big event, SIAL provided an opportunity and a gateway for showcasing local and regional products and services.

The DOST-FIC showcase at SIAL featured the spray dryer and vacuum fryer and the established FICs (Regions 2, 8, 11) along with a free taste of their developed products using the equipment. More than 30 potential buyers expressed interest and appreciation of the equipment and products.

The same showcase was exhibited in another international event, the ASEAN Food Conference 2015.

Fora/Consultative Meeting

A total of seven fora/consultative meetings were organized during the year. In step with AEC, the TSD initiated a technology matching forum with the industry conducted at the Sofitel Philippine Plaza, Manila in February. Prior to the forum, a preliminary consultative meeting amongst its research and technical services groups to identify the R&D scenario facing them was conducted. After which, the forum with industry was held aimed towards the development of a technology matching plan where about 40 participants from various industry sectors (food industries, electronics, pharmaceuticals, shipbuilding, material science) attended.

Another was a forum with stakeholders on Emergency Food Reserve (EFR) to facilitate the eventual transfer of the technology to prospective adopters where 62 attended coming from different regions comprising of LGUs, government agencies, private individuals, and NGOs. This was followed by the "Kapihan with Stakeholders" in time with the 114th ITDI Founding Anniversary in July, with guests from various industry sectors.

Other fora were those on nanotechnology during the NSTW 2015, FIC at SIAL ASEAN MANILA 2015, and the launching of the bioreactor inoculant by EBD.

Knowledge bank

Amidst constraints in resources (e.g., space, acquisitions) efforts in building up the ITDI knowledge bank is pursued. Its in-house collection of completed R&D projects, and related reports along with other Filipiniana materials were catalogued/encoded to the Science Integrated Library Management System (SILMS) now totaling about 540. Forum proceedings and/or project reports and all produced publications form part of the in-house collection.

This collection is beefed up with the continuous build-up of an on-line resource or e-collection comprising of e-books and e-journals relevant to ITDI's areas of discipline. About 170 e-books and journals are now contained in this on-line resource and are readily accessible. In addition, four issues of Current Awareness Service (CAS) were released and free access to four on line sites for journals was facilitated. And despite its constrained resources, the library has served almost a hundred users during the year.

Intellectual Property

IPs granted and filed/pending in 2015:

Six awarded patents (Utility Model):

- Process of preparation of natural health supplement from *Anona muricata* leaves in capsule
- Process preparation of tea from *Anona muricata* leaves
- Process of preparation of natural health supplement from *Anona muricata* fruit in capsule
- Process preparation of tea from *Anona muricata* fruit
- Montmorillonite functionalized nanofibers for adsorption of organic molecules through electrospinning
- Process of producing montmorrilonite functionalized nanofibers for adsorption of organic molecules

Fifteen IPs (Utility Model) filed/pending:

- Process for producing biodegradable composition comprising thermoplastic nanocomposite and polyactic acid (process)
- Biodegradable composition comprising thermoplastic nanocomposite and polyactic acid and process of producing thereof (product)
- Rice wine (*tapuy*) prepared from a novel *Bubod* starter (process 1)
- Rice wine (*tapuy*) prepared from a novel *Bubod* starter (process 2)
- Granulated *bubod* starter for rice wine (process)
- Granulated *bubod* starter for rice wine
- Process of preparing *bubod* starter for rice wine (*tapuy*) Process 1
- Process of preparing *bubod* starter for rice wine (*tapuy*) Process 2
- Process of preparing *bubod* starter for rice wine (*tapuy*) Process 3
- Cookies using squash puree as an ingredient
- Process of preparing squash puree
- Process of preparing squash puree using lactic acid as acidulant
- Process of preparing squash puree using glucono delta lactone as acidulant
- Process of preparing squash soup using squash puree as ingredient
- Process of producing montmorrilonite functionalized nanofibers for adsorption of organic molecules

- 48 ISBN for ITDI R&D terminal reports
- 1 copyright (Food processing training program for the Republic of Vanuatu)

Outcome 6

Improved quality healthcare and quality of life through science, technology, and innovation

ITDI has made significant contributions to health and wellness R&D particularly those driven by national issues like dengue control, salt iodization, natural health supplements, and packaging-related contaminants' determination

Extraction, characterization and bio-assay for **larvicidal activity** of some Philippine medicinal plants

A continuing project funded by National Research Council of the Philippines (NRCP), the Chemicals and Energy Division in collaboration with the Standard and Testing Division investigated the larvicidal activity of the crude extracts from *Citrus grandis (L.) Osbeck (suha)* peels against the dengue vector, *A. aegypti*. Results of the study showed excellent toxicity against the adult *A. aegypti* and its egg including 3rd and 4th instar larvae. The shell wastes of *A. occidentale* were also found to be very potent against *A. aegypti* eggs.

The second phase of the project will concentrate on the formulation of mosquito larvicides, adulticides and ovicides in nano-emulsified/pelletized forms using the plant extracts.

Adulticidal bioassay of *A. aegypti*
(Closed cylinder method)

Enhancing the capacity of the **Bantay Asin task force** in the monitoring of adequately iodized salt nationwide

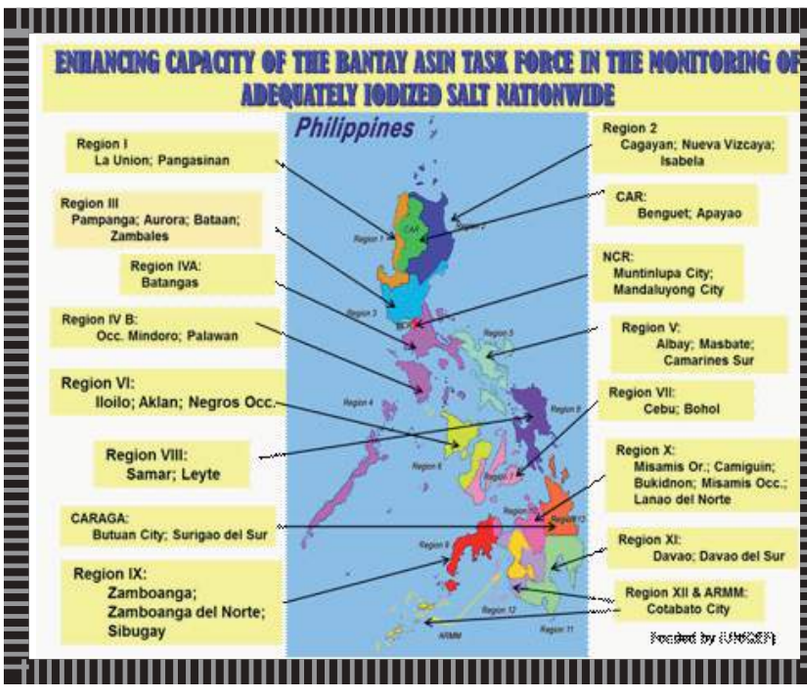
Capacity building of the Regional Bantay Asin Task Force in support to the program initiatives of the National Salt Iodization Program in the effective implementation of the ASIN Law funded by UNICEF was carried out. The Chemicals and Energy Division representing ITDI, as a member of the Technical Working Group on National Salt Iodization Program (TWG-NSIP) conducted training and orientation on the operation, maintenance, and calibration of the WYD Iodine Checker in monitoring adequately iodized salt. All regions were visited and lecture-demo trainings were provided to the task force.

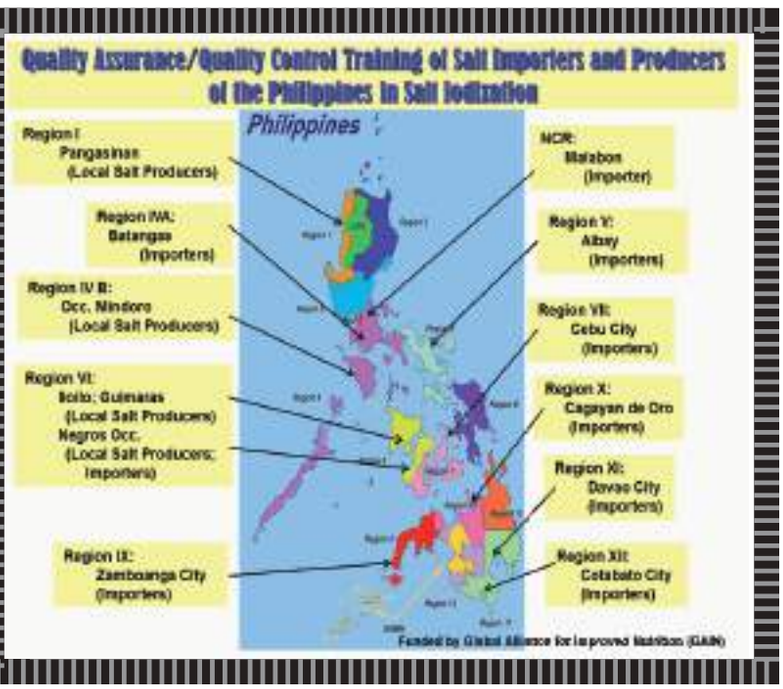
UNICEF donated WYD Iodine Checkers to Bantay Asin Task Force which includes the regional offices of the Department of Health (DOH), Food and Drug Administration (FDA), National Nutrition Council (NNC), and selected local government units under existing MOU with the Lady Municipal Mayors Association of the Philippines (LMMAP).

Quality assurance/quality control training in **salt iodization** of salt importers and producers of the Philippines

A collaborative activity between the ITDI and DOST Regional Offices through the initiative of the Global Alliance for Improved Nutrition (GAIN), the project is a support to the salt iodization program of the Philippines through a quality assurance program. The GAIN-funded project had three components namely:

1) Modelling of internal quality assurance in three levels/types of iodization facility (imported salt, solar salt production, cooked salt) in Batangas, Davao, Occidental Mindoro and Pangasinan;
2) Capacity assessment of ITDI and DOST-regional laboratories to support salt importers in the implementation of a quality assurance system which include training of trainers; and,
3) Training of salt producers/iodizers on improved techniques and proper internal quality assurance procedures.





Purification and production of **pharmaceutical grade calcium carbonate**

A pharmaceutical grade calcium carbonate was developed through a purification process involving recalcination, hydration, and carbonation; followed by drying, pulverizing, and autoclaving. The product was then analyzed for physical and chemical properties and the results were compared with the specifications set by the United States Pharmacopeia for calcium carbonate. Formulation studies were also done to produce antacid calcium tablet and chewable calcium supplement.

Dietary calcium carbonate supplement (chewable tablet)

Antacid calcium carbonate (chewable tablet)

Extraction of BPA in canned sardines

Operation of Gas Chromatograph Mass Spectrometer (GCMS-QP2010 Plus) for detecting packaging-related contaminants

Toxic migrants in packaged foods and beverages: addressing the safety issues on **packaging related contaminants** in foods-phase 2

PTD researchers developed methods for testing packaging materials on the presence of some apparently health-noxious substances like Bisphenol A, Acetaldehyde, Phthalates and Benzophenone to address safety issues on packaging-related contaminants. The project staff surveyed canned products from the shelves of local supermarket, performed analyses on PET bottles, HDPE bottles, and paper-based packages that come into contact with food and determined the food contact suitability of some commonly used packaging materials for traditional sweets like *polvoron, sampaloc* candy, *pastillas* and *yema*.

Samples of OPP/CPP, PET/CPP/PE, vacuum metallized film, foil laminate, and disposable PP containers were subjected to migration test and found to conform to approved specification limits for articles intended for food packaging. Results also showed that 94% of the cellophane samples did not conform to approved specifications limits for articles intended for food packaging while 53% of the Japanese paper samples failed the migration test.

Various HDPE bottles, PET bottles and cling wraps were found to contain tolerable amounts of dioctyl phthalates with 83.67%, 83.32% and 99.30% recoveries. Results for 27 samples of paper-based materials intended for food packaging showed minimal benzophenone concentration with 97.98% and 100.57% recoveries.

Twenty-three samples of canned goods randomly selected from a local supermarket were tested for cadmium, lead and tin. Heavy metal test for canned sardines, corned beef, pork and beans and canned vegetables was outsourced from Sentrotek Laboratory (Mandaluyong). Two brands of canned sardines and two brands of corned beef marginally exceeded the recommended limits for lead, hence another batch of samples was sent for the same test and subcontracted to Intertek (Makati) and FAST laboratories (Cubao, QC). The samples were tested and results were within the limits set by EU or CODEX. This project was funded by the DOST-GIA program.

Field testing and validation study of retort food
(chicken *arroz caldo*) as disaster mitigation/relief food
using DSWD's and LGU's distribution protocols

Ready-to-eat (RTE) chicken *arroz caldo* was developed as a disaster mitigation/relief food to address immediate hunger of disaster/ calamity survivors and providers of services (medical, military personnel, and volunteer groups) within the next 48 hours. It is categorized as a first-stage-disaster-food which means, ready-to-eat, without preparation and drinkables. The product is conveniently packed in an easy-open-stand-up retort pouch and can be directly consumed from the package.

Field testing and validation study of RTE chicken *arroz caldo* in retort pouch using the distribution protocols of the Department of Social Welfare and Development (DSWD) and Local Government Unit (LGU) of Albay were conducted. The structure of the retort pouch and transport packaging was so designed and developed to withstand DSWD's and LGU's protocols which include distribution by land, sea surface, and aerial drop.

Twenty five thousand pouches of RTE chicken *arroz caldo* were commercially produced using a toll packer's facility. After completing the two-week incubation, 167 boxes (@30 pouches/box) of RTE chicken *arroz caldo* were delivered to the DSWD's warehouses in Cebu, Davao, and NCR; and LGU Albay's warehouse in Legaspi City.

The test samples were then randomly evaluated upon arrival in the warehouses for the presence of pinholes, leak, flex cracks, bulging etc. While compression was observed on the corrugated box, no damage on RTE chicken *arroz caldo* was documented. After four months of storage, all samples in all DSWD warehouses and LGU warehouse were still acceptable in terms of physico-chemical, sensory, and microbiological properties. No product damage due to rodent infestation was reported. Shelf life testing is still on-going.

Outcome 8:

Science-based weather information and climate change scenarios with associated impact assessments that enable concerned agencies to develop appropriate mitigation strategies for a disaster and climate change resilient Philippines.

Addressing immediate food shortage and water potability concerns in disaster communities nationwide, ITDI provided innovative solutions through the development, production, and distribution of ready-to-eat (RTE) relief foods and candle-type ceramic water filters.

Branded as “Pack of Hope”, the RTE chicken *arroz caldo* was given a certificate of recognition for product and packaging innovation in the Katha Awards during the International Food Exhibition (IFEX) 2015 held at the SMX, Mall of Asia.

Production of **candle-type ceramic water filters**

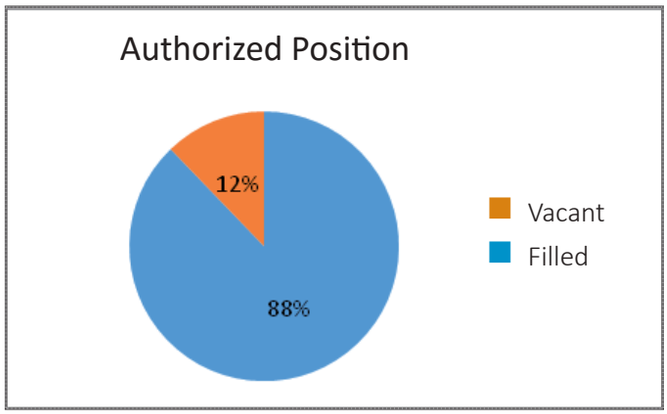
A total of 10,000 pieces of candle-type ceramic water filters (CWF) using Vigan clay were produced and field tested at the Shelterville Resettlement Area in Vigan City. Initially, the raw water from deep wells in the area did not pass the microbiological criteria set by the Philippine National Standards (PNS) for drinking water therefore, was not potable. After using the candle-type ceramic water filter with anti-microbial coating, the filtered water already conformed to the PNS criteria for drinking water.

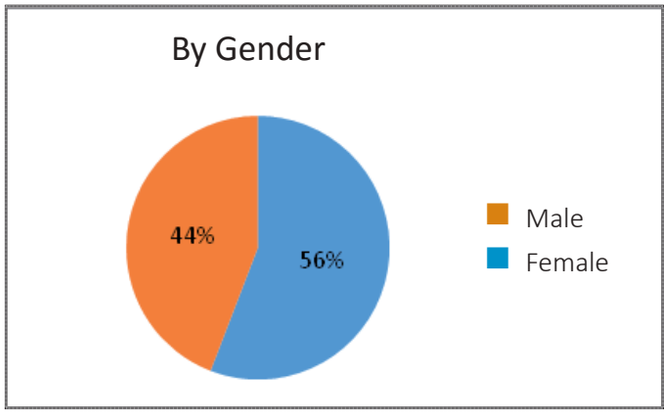
To date, production facilities for CWFs have been established in the following localities: (1) Arayat, Pampanga; (2) Vigan City, Ilocos Sur; (3) Sta. Maria, Isabela; and (4) CAR. The next production sites will be in Region 5 (Bicol), Region 10 (CD), and LGU-Ilocos Sur.

About 1,200 pieces of candle-type CWFs were assembled and packaged for the Yolanda victims while 6,000 more had already been distributed nationwide.

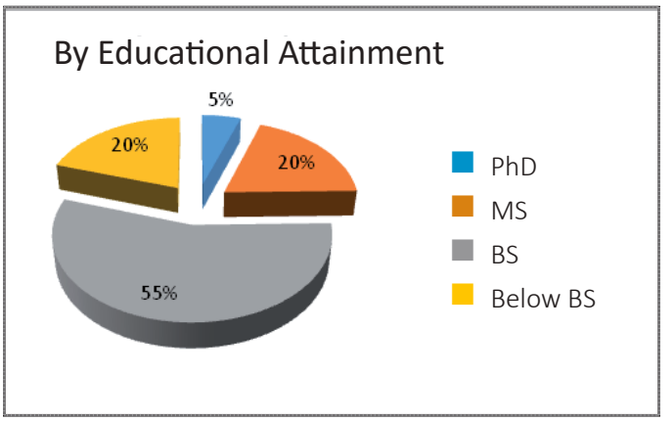
HUMAN RESOURCES

As of October 2015, ITDI has a total of 369 authorized positions, of which 324 (87.8%) are filled and 45 (12.2%) are vacant. Of the current manpower, 181 (55.9%) are female and 143 (44.1%) are male.

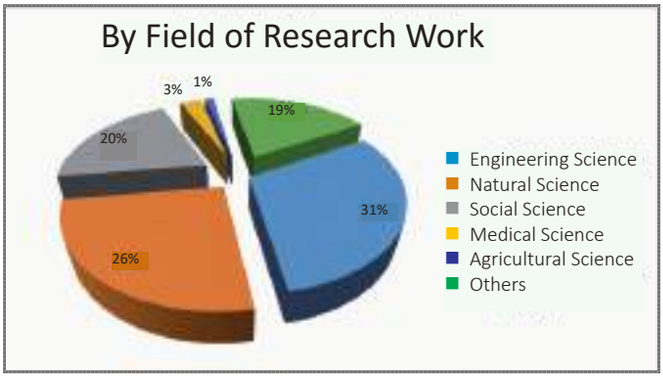




Its manpower profile by educational attainment is as follows:



The table and pie chart below show the diverse field of research work of ITDI's manpower for the year.



Field of Research Work	Frequency	Percentage
Engineering Science	99	31%
Natural Science	83	26%
Social Science	65	20%
Medical Science	10	3%
Agricultural Science	4	1%
Others	63	19%
TOTAL	**324**	**100%**

The Institute with its staff development program continuously strengthen capabilities of its employees through provision of formal and informal training opportunities. Its manpower participated in 95 foreign trainings, workshops, conferences, and symposium as well as in 216 locally sponsored trainings.

Six ITDI staff pursued their Master's degree in the fields of Food Science, Development Communication and Chemistry through scholarship grants by the Human Resources Development Program (HRDP) of the DOST-SEI. Two staffs availed of foreign scholarships in the field of packaging technology and another two took their Doctorate degree in the fields of Materials Science Engineering and Chemistry.

The following ITDI staffs graduated in 2015:

Doctorate Degree	
Annabelle V. Briones	Engineering
Violeta B. Conoza	Development Communication
Aldrin D. Calderon	Energy Engineering
Master's Degree	
Rocheel Lee C. Deluta	MBA
Michelle E. Evaristo	Food Science
Federico E. del Pozo, Jr.	Industrial Engineering and Management
Jo Ann C. Sy	Material Science Engineering
Vivian U. Lagura	Material Science Engineering

The ITDI Staff Development Committee (SDC) in coordination with the different divisions organized the following in-house seminars/training:

- Awareness/Information Dissemination on DOST IP Policy and DOST RDIsTechnology Transfer Protocol
  September 23, 2015, EBD Conference Room, 45 participants

- PCAARRD-funded training workshop on Technical Report Writing for Presentation and Publication in a Refereed Journal
  September 14-18, 2015, ITDI Metrology Conference Room, 30 attendees (25-ITDI, 5-other R&D Institutes)

- DOST HRDP-funded training on Experimental Designs Applicable in DOST Researches
  November 3-5, 2015, ITDI Metrology Conference Room, 35 attendees (30-ITDI, 5-other RDIs)

For this year, 22 new employees were hired and deployed in the MSD/ADMATEL, STD, PTD, OD/ODD, Adm, FPD, and CED; while 22 regular staff were promoted.

FINANCIAL MANAGEMENT

For 2015, ITDI has a total budget allotment amounting PhP253,765,000.00, broken down into three major allocations, the Personal Services (PS) inclusive of RLIP, Maintenance and Other Operating Expenses (MOOE) and the Capital Outlay (CO). As shown in figure 1, the PS has the largest allocation of about 76%, followed by the MOOE 19% and the remaining is for CO 5%, which is divided into Equipment Outlay and Repair of Buildings.

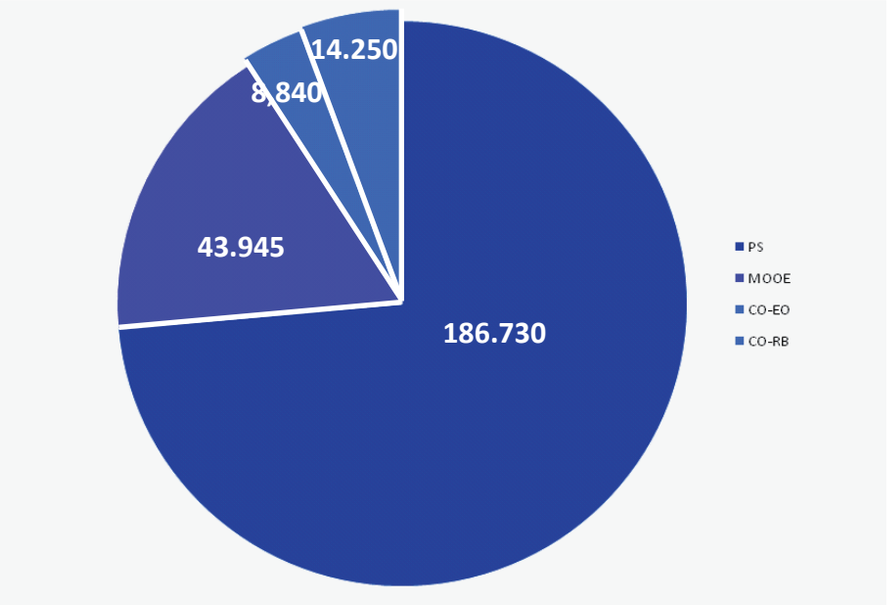


Figure 1 – Budget Allotment (in millions)

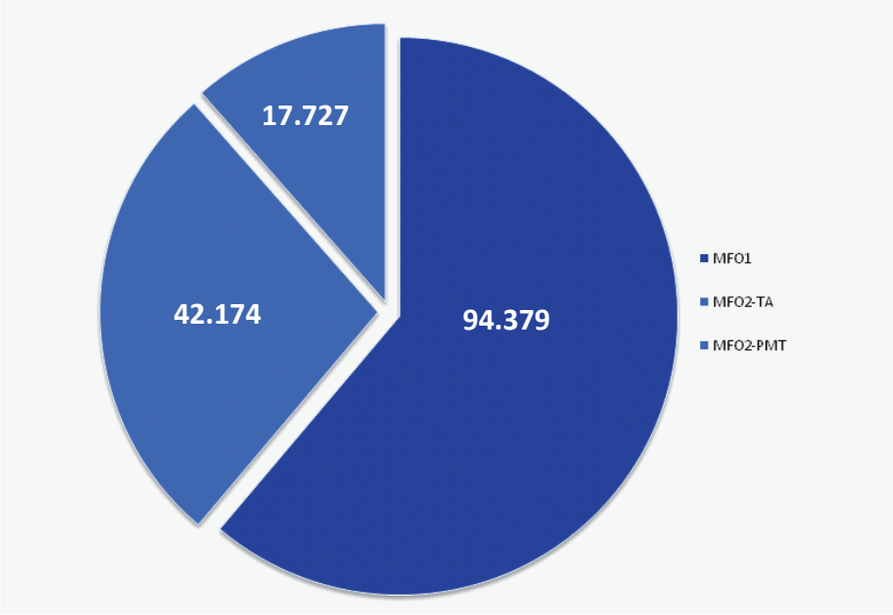


Figure 2 – Programs and Project Allocation (in millions)

In terms of programs and project activities, ITDI has a total allotment of PhP 154,280,000 from two major funding sources, from the General Appropriations Act (GAA) and from other government funding agencies. Research and Development, which is the Major Final Output (MFO 1) of the Institute was allocated 61% while Technical Advisory Services (MFO 2) received the remaining allocation apportioned for Testing and Analysis (TA-27%) and Promotion and Marketing of Technologies (PMT-12%).

AWARDS

2015 NAST Awards, December 4, 2015, Manila Hotel
ITDI-Best Institute with the most number of utility models registered for 2014-2015 at IPO.

Utility Model Registration Award:

1. "Process of preparation of natural health supplement from *Annona muricata* fruits"
(Dr. Rosalinda C. Torres, Carmelita O. Manalo, Teresita S. Bonifacio, Evelyn B. Manongsong, Elvira L. Arrogante, Romulo R. Estrella, Eduardo A. Lanto, Dr. Cynthia N. Ochona, Yolanda C. Paras, Juliet T. Barcala, Regin Glen Ortiz) 2-2014-000307

2. "Process of preparation of tea from *Annona muricata* fruits"
(Dr. Rosalinda C. Torres, Carmelita O. Manalo, Teresita S. Bonifacio, Evelyn B. Manongsong, Elvira L. Arrogante, Romulo R. Estrella, Eduardo A. Lanto, Dr. Cynthia N. Ochona, Yolanda C. Paras, Juliet T. Barcala, Regin Glen Ortiz) 2-2014-000308

3. "Process of preparation of natural health supplement from *Annona muricata* leaves in capsule"
(Dr. Rosalinda C. Torres, Carmelita O. Manalo, Teresita S. Bonifacio, Evelyn B. Manongsong, Elvira L. Arrogante, Romulo R. Estrella, Eduardo A. Lanto, Dr. Cynthia N. Ochona, Yolanda C. Paras, Juliet T. Barcala, Regin Glen Ortiz) 2-2014-000346

4. "Process of preparation of tea from *Annona muricata* leaves"
(Dr. Rosalinda C. Torres, Carmelita O. Manalo, Teresita S. Bonifacio, Evelyn B. Manongsong, Elvira L. Arrogante, Romulo R. Estrella, Eduardo A. Lanto, Dr. Cynthia N. Ochona, Yolanda C. Paras, Juliet T. Barcala, Regin Glen Ortiz) 2-2014-000347

5. "Montmorillonite functionalized nanofibers for adsorption of organic molecules through electrospinning"
(Dr. Blessie A. Basilia, Ner Rodriguez) 2-2011-000678

6. "Process of producing montmorillonite functionalized nanofibers for adsorption of organic molecules through electrospinning"
(Dr. Blessie A. Basilia, Ner Rodriguez) 2-2015-000397

DOST International Publication award:

1. "Characterization and bioassay for larvicidal activity of *Anacardium occidentale* (cashew) shell wastes fractions against dengue vector *Aedes aegypti"*
(Dr. Rosalinda C. Torres, Alicia G. Garbo, Rikkamae Zinca Marie L. Walde), ISSN 0932-0113 Parasitology Research 114, 2015.

2. "Larvicidal activity of *Persea americana Mill.* against *Aedes aegypti"*
(Dr. Rosalinda C. Torres, Alicia G. Garbo, Rikkamae Zinca Marie L. Walde), ISSN 1995-7645 Asian Pacific Journal of Tropical Medicine 7, 2014.

3. "Larvicidal activity of *Garcinia mangostana* fruit wastes against dengue vector *Aedes aegypti*"
(Dr. Rosalinda C. Torres, Alicia G. Garbo, Rikkamae Zinca Marie L. Walde), ISSN 1018-7081 Journal of Animal and Plant Sciences 25, 2015.

4. "Biomimetic piezoelectric quartz crystal sensor with chloramphenicol-imprinted polymer sensing layer"
(Dr. Benilda S. Ebarvia, Isaiah E. Ubando, Fortunato-Sevilla), ISSN 0039-9140 Talanta, 2015.


National Research Council of the Philippines

hereby awards this

Certificate of Excellence

to

David Herrera, Myra Tansengco, Judith [illegible], Ricky Berraye, Reynaldo Baguerra, Antonio Celajes Jr. and Ronald Dongpil

whose poster entry entitled, "Utilization and Treatment of Dairy Effluent through Biogas Production using the ITDI Portable Anaerobic Digester"

was adjudged as the THIRD PRIZE WINNER in the 2015 NRCP POSTER EXHIBIT AND COMPETITION conducted during the 82nd NRCP General Membership Assembly held on 11 March 2015 at the Philippine International Convention Center, Pasay City

FILEMON A. URSABIA JR., Ph. D.
President

NRCP Poster Competition, 82nd Membership Assembly Scientific Conference, March 9, 2015

Third Prize Winner
"Utilization and treatment of dairy effluent thru biogas production using the ITDI portable anaerobic digester"
David L. Herrera, Myra L. Tansengco, Judith C. Tejano, Jose Ricky E. Berraye, (EBD)

4th Prize Winner
"Surface characterization and binding isotherm evaluation of tailor-made microdroplets for tetracycline"
Isaiah E. Ubando, Benilda S. Ebarvia, (STD)

AUN SEED-Net Regional Conference on Electrical and Electronics Engineering co-located with the 11th ERDT Conference

Best Paper Award
"Reliability and material characterization of sintered Ag die attach on varying nitrogen levels for high temperature"
R. Clemente, B. Basilia, (MSD)

Special Recognition KATHA Awards

Product and Packaging Innovation, International Food Exhibition (IFEX)

- 'Pack of Hope' (RTE chicken *arroz caldo*)
- 'Mighty Sweet Potato'
- 'Tsukudani Style Smoked Fish'
- 'Frozen Durian in multiple barrier packaging', (PTD)

2015 PCIEERD Outstanding R&D

(PCIEERD's 5th anniversary celebration, June 30, 2015, Marriott Hotel, Manila)

Finalist (Special concerns category)
"Effects of kappa-carrageenan on the physico-chemical properties of thermoplastic starch"
Annabelle Flores, (FPD)

Finalist (Industrial technology category)
"Development, prototyping and field performance testing of ceramic water filter systems using Philippine red clays with nano antimicrobial coating", Blessie A. Basilia, Josefina R. Celorico, Edmar P. Casa, Rosemarie B. Antinopo, Juanita B. Salvador, Leonora E. Samson, Ruben C. Loberiano, Dr. Nuna E. Almanzor, (MSD)

14th International Symposium on Biological and Environmental Reference Materials

(BERM 14)-Gaylord National Resort & Convention Center, Maryland USA, October 11-15, 2015

Honorable Mention Award
"Development of a reference material for histamine in canned tuna"
Benilda S. Ebarvia, Sharlene R. Cabanilla, Alma Cruz, Aaron Dacuya, Natividad R. Mamplata, (STD)

INTERNATIONAL SCIENTIFIC LINKAGES

Nature of Scientific Linkages		Name of Institutions / Organizations
Certified Laboratory Member	==	International Safe Transit Association (ISTA, USA)
Board Director	==	ISTA in the Asia Pacific Region
Member	==	International Association of Packaging Research Institutes (IAPRI, UK)
ETV Collaboration / Cooperation	==	Korea Environmental Industry and Technology Institute (KEITI)
		ETV Korea
		International Working Group (IWG) ETV
		DHI – Denmark
		Universite de Bordeaux
Technical Cooperation	==	Vanuatu Government - Department of Industry
		Republic of Nauru - Department of Foreign Affairs and Trade
		National Metrology Institute of Australia (NMIA)
Network	==	Institute for Global Environmental Strategies
		Mitsubishi Research Institute
Cooperation	==	Photocatalysis Industry Association of Japan
Capacity Building of Internal QA/ QC of Salt Industry in the Philippines	==	Global Alliance of Improved Nutrition (GAIN)
Enhancing Capacity of Bantay Asin Task Force Nationwide	==	UNICEF
Laboratory Evaluation of Paper Analytical Device (PAD) in Monitoring Iodine Level in Fortified Salt in the Philippines	==	UNICEF
Research Collaboration on Corrosion of Structural Steel Products	==	National Institute for Materials Science (NIMS), Japan
Research Collaboration on Fiber Composites	==	Korean Institute of Materials Science (KIMS), Korea
Focal Person for the Philippines	==	ASEAN Sub Committee on Food Science and Technology (ASCFST)

Nature of Scientific Linkages		Name of Institutions / Organizations
Technical Cooperation/Capacity Building	==	International Bureau of Weights and Measures (BIPM) General Conference on Weights and Measures (CGPM) Asia Pacific Metrology Programme (APMP) Asia Pacific Legal Metrology Forum (APLMF) ASEAN Consultative Committee on Standards and Quality (ACCSQ) ASEAN Experts Group on Metrology (ASEAN EGM) National Accreditation Body of Germany (DAkkS) National Metrology Institute of Germany (PTB) National Metrology Centre of Singapore National Institute of Metrology Thailand (NIMT) National Metrology Laboratory-SIRIM Berhad, Malaysia Vietnam Metrology Institute (VMI) Research Center for Calibration, Instrumentation and Metrology, Indonesia
Expert Advice, Training and M.S. in Metrology Scholarship	==	Korea Research Institute of Standards and Science (KRISS)
Collaboration	==	Asia Pacific Economic Cooperation (APEC) Virtual Center
Philippine Representative	==	UN Secretary General's Mechanism for Investigation of Alleged Use of Chemical & Biological Weapons
Member (PTD)	==	Asian Packaging Network (APN)
Technical Cooperation Project	==	PTD and Japan International Cooperation Agency (JICA)

Scientific Papers Published

Activated carbon from spent coffee grounds
J. Pondevida, A. Briones, L. Hermosura, M. Carandang, A. Mallillin, R. Esperanza, N. Deocampo, ISBN 978-971-9646-34-1, Philippines

A comparative study on the effect of packaging materials (retortable pouch, glass and metal cans) on the quality of sauteed shrimp paste
G. Noceja, F. Loberiano, E. Orendain, A. Quirante, A. Alconga, ISBN 978-971-9646-43-3, Philippines

Application of Nanotechnology in Providing Potable Water
J. Celorico, B. Basilia, E. Casa, R. Antinopo, J. Salvador, L. Samson, N. Almanzor, Proceedings of the 14th ASEAN Food Conference, SMX Convention Center, Mall of Asia, Pasay City, June 24-26, 2015, Philippines

Assessment of product fragility and cushion performance data for home décor
F. Victoria, E. Nolasco, E. Orendain, C. Puno, ISBN 978-971-9646-56-3, Philippines

Atmospheric Corrosion Exposure Study of Carbon Steels in Philippine Environments
A. Monsada, M. Margarito, L. Milo, E. Casa, R. Loberiano, B. Visaya, J. Zabala, A. Maglines, S. Harada, T. Shinohara Proceedings of the International Symposium on Atmospheric Corrosion in Asian Area – JSCE Materials and Environment 2015, May 18, 2015, Tokyo, Japan

Bench-scale production and pigment extraction of food color produced by monacus purpureus in rice using solid substrate fermentation
F. Cubol, JP. Jose, U. Bigol, E. Montigue, M. Razon, ISBN 978-971-9646-47-1, Philippines

Binding characteristics of histamine imprinted microbeads based on polymetachrylic acid
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Development of disposable cutleries from biodegradable nanocomposites
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A. Flores, M. Manalo, U. Dollete, T. Dudang, L. Montevirgen ISBN 978-971-9646-68-6, Philippines

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Development of ready-to-eat (RTE) dried cavendish banana (*Musa acuminate*)
T. Palomares, J. Alejo, ME. Falco, G. Diopol, R. Barcala, C. Umali, CF. Falia, H. Caña, R. Enriquez, R. Dudang, Jr., ISBN 978-971-9646-53-2, Philippines

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Development of natural food coloring from Philippine yam or *ube (Dioscorea alata)*
MD. Villaseñor, C. Bilbao, N. Aidasani, C. Umali, R. Balderama, ISBN 978-971-9646-55-6, Philippines

Development of rubber-silicate nanocomposites using natural rubber and locally synthesized nanoclay for rubber based sports products
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Enhancing the production of culture media preparation for biotechnology through increased availability of laboratory equipment and facilities
D. Vergara, R. Esguerra, C. Valdecañas, R. Adan, M. Prudencio Jr., J. Beraye, ISBN 978-971-9646-32-7, Philippines

Establishment of a food safety system for traditional Philippine *sorbete*s in some cottage to small-scale manufacturers
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Establishment of a food safety system for *taho* manufacture in the Philippines
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Establishment of processing methods for the production of natural sweetener from nipa sap *(Nipa Fruitcans Wurmb)*
N. Ambagan, C. Villaruz, R. Belandres, O. Evangelista, E. Magora, AFC 2015 Book of Abstracts, Philippines

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Expanding the Role of Advanced Testing Laboratories in the Philippines
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R. Esguerra, D. Herrera, M. Tansengco, J. Tejano, R. Retamar, G. Sikat, J. Beraye, M. Yao, ISBN 978-971-9646-42-6, Philippines

Genetic manipulation of yeast, Saccharamycescerevisiae for simultaneous fermentation and saccharification of starchy materials
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Influence of nanoparticles on the properties of bionanocomposites from cassava
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J. Celorico, J. Salvador, L. Samson, M. Que, R. Antinopo, M. Daan, ISBN 978-971-9646-29-7, Philippines

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Nanocopper as anti microbial agent for ceramic water filter
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Optimization of analytical procedure for determination of residual toluene in printed flexible packaging materials using headspace – Gas chromatography/mass spectrometry (HS-GCMS)
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Pilot scale standardization of product and processes using drum drying technology on selected materials (mango, banana and *makapuno*)
ME. Falco, A. Flores, T. Palomares, E. Magora, S. King, J. Magara, P. Marasigan, ISBN 978-971-9646-63-1, Philippines

Production of high grade silica from rice hull ash
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Production of nano silica zeolite
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Process improvement, standarization and pilot scale production of traditional rice wine
M. Evaristo, R. Gomez, D. Chang, N. Aidasani, R. Balderama, ISBN 978-971-9646-28-0, Philippines

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Rapid detection and monitoring of adulterant papaya seeds *(Caricu papaya L.)* in black pepper *(piper nigrum L.)* by PCR-cased methods
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Rehabilitation of the fluidized bed system and carbonization equipment for the enhancement of the energy R&D activities
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Reliability and material characterization of Sintered Ag Die attach on varying nitrogen levels for high temperature micro-electronic application
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Round robin antibacterial test of photocatalytic materials based on ISO 17094 among ASIAN countries
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Selection of CO_2 adsorption technology for small scale low-pressure biogas from backyard farm swine industry in the Philippines using Geographic Information System and Analytic Hierarchy process
A. Calderon, B. Basilia, A. Monsada, E. Casa, L. Milo, M. Margarito, International Journal of Engineering Research and Development, USA

Shelf Life improvement of selected sweets, bakery products and snack foods through the application of active packaging technology – Phase 1: Honey Glazed pili nuts, *bukayo* and squid rings
J. Talamor, R. Garalde, D. Tañafranca, ISBN 978-971-9646-69-3 Philippines

tability studies and application tests of *ube* powder in pharmaceutical and personal care products
R. Torres, C. Manalo, E. Manongsong, E. Arrogante, R. Estrella, E. Lanto, A. Briones, ISBN 978-971-9646-37-2, Philippines

Storage study of ground roasted coffee under conditions practiced at home
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Surface characterization of modified natural zeolite
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Surface modified zeolite for oil spill decontamination
C. Gacho, C. Borromeo, MJ. Capule, B. Gutierrez, R. Adan, C. Valdecañas, M. Malabanan, J. Celorico, ISBN 978-971-9646-54-9, Philippines

Synthesis of epichlorohydrin from glycerol
C. Bulan, C. Mendoza, N. Deocampo, R. Esperanza, A. Briones, L. Hermosura, ISBN 978-971-9646-49-5, Philippines

The effect of plasma treatment on the mechanical properties of polypropylene-abaca fiber composites
M. Paglicawan, C. Emolaga, B. Kim, Proceedings of the International Symposium on Green Manufacturing and Application (ISGMA 2015), June 23-27, 2015, Qingdao, China

Training Program on food processing for the Republic of Vanuatu
R. Belandres, R. Gomez, O. Evangelista, M. Evaristo, Copyright Nov. 2015, ISBN 978-971-9646648, Philippines

Treatability study for the remediation of oil-contaminated water using chitosan CACO3 composite
E. Ongo, C. Valdecañas, B. Gutierrez, M. Capule, R. Adan, M. Malabanan, ISBN 978-971-9646-38-9, Philippines

R&D Projects Completed

Activated carbon and charcoal briquettes from waste peels of selected fruits and root crops
J. Herrera

ASEAN Food Conference (2015)
MD. Villaseñor

Assessment of product fragility and cushion performance
F. Victoria

Application of modified atmosphere packaging (MAP) technology to enhance the shelf life and quality of fresh fruits and vegetables
F. Loberiano

Application of retort packaging technology in the development of disaster mitigation/relief foods : rice meal
F. Loberiano

Automation and application of ITDI-developed water spray retort for rice-based disaster food
L. Montevirgen

Bench scale production nano-precipitated calcium carbonate for food application
B. Basilia, J. Celorico

Binding studies and characterization of tetracycline imprinted polymer sensing layer for a chemical sensor based on a Piezoelectric Quartz Crystal (NRCP) (Project 1)
B. Ebarvia

Conduct of life cylce assessment of HDPE and LLDPE grocery bags and polystyrene paper (Assessment of potentially non-environmentally acceptable products/ packaging)
R. Esguerra, L. Egay

Design and fabrication of equipment for the production of local cocoa products (Technological support for the upgrading of local cacao and cocoa industry)
R. Esguerra

Design of CO_2 capture system utilizing molecular sieve membrane technology
A. Bawagan, M. Tansengco

Design of purification system for fuel-grade ethanol using zeolite based molecular sieve
C. De Vera

Development of a small scale in-vessel composter for biodegradable solid wastes
M. Tansengco

Development of transport packaging technology for cut flowers (Malaysian mums and Anthurium, Yr 2)
D. Tañafranca

Development of natural food coloring from the Philippine purple yam (*Dioscorea alata*)
C. Bilbao

Establishment of an Advanced Device and Materials Testing Laboratory for the semiconductor and electronics manufacturing industries (ADMATEL) Phase 4-OPERATION of ADMATEL
B. Basilia

Extraction characterization and bio-assay for larvicidal activity of some Philippine medicinal plants Yr. 3
R. Torres

Field testing and validation of study of retort food *(arroz caldo)* as disaster mitigation/relief food using DSWD's and LGU's distribution protocols
D. Tañafranca

Fluidized bed combustion and gasification of Refuse Derived Fuel (RDF) from biomass-plastic wastes for heat and power generation
A. Bawagan

Improving the quality of solid cocoa liquor including molded cocoa nibs & developing the capability of small scale processors in the manufacture of intermediate cocoa products
MD. Villaseñor

R&D Projects Completed

Microbial community and biochemical profiling for microbial augmentation and development of quality indicators for cacao fermentation and processing
Study 6: Development of quality indicators for fermented, dried and roasted cacao
U. Bigol

Modified starch for various industrial application
Sub-project 1: Production of starch acetate
Sub-project 2: Production of cross-linked starch
Sub-project 3: Production of heat-treated starch
L. Hermosura

Nano copper impregnated ceramic water filters: production, application and performance testing
J. Celorico

Nano zeolite: production, application and performance testing
J. Celorico

Optimization of analytical procedure for determining residual toluene in printed packaging films
D. Alcalde, Jr.

Oxidized starch for various industrial application
L. Hermosura

Pilot scale standardization of product and processes using drum drying on selected raw materials (mango banana and *makapuno*)
ME. Falco

Pilot-scale treatment of wastewater using anaerobic sequencing batch reactor (ASBR)
M. Tansengco

Production of nano-precipitated calcium carbonate (industrial grade)
J. Celorico

Production of Secondary Certified Reference Materials and Provision of Proficiency Testing for Metals (Elemental Standard Solutions) in Water Project 1.
H. Bion

Purification and production of pharmaceutical grade calcium carbonate
R. Torres

Setting-up of Sewage Treatment Plant in the DOST Bicutan Compound
R. Esguerra

Southeast Asian Atmospheric Corrosion Exposure Study (SEA ACES) of steels, electronics equipment and components in Philippine marine environment - Year 1
A. Monsada

Standardization of intermediate raw materials from sweet potato: dehydrated grates and frozen puree
R. Gomez

Standardization and application of cassava products processing technology
M. Evaristo

Toxic migrants in packaged foods and beverages: addressing the safety issues on packaging related contaminants in foods - Phase II
J. Diaz

Utilization of nano-sized calcium carbonate as:
(a) neutralizing agent in pineapple sugar (as liquid sugar) processing (b) alkalizing agent in cocoa powder making
C. Bilbao

Validation of improved *tablea* processing using the designed and fabricated equipment
MD. Villaseñor

Scientific Papers/ Posters Presented

ORAL PRESENTATION

Application of nanotechnology in providing potable water
ASEAN Food Conference, SMX Convention Center, MOA, Pasay City, June 25, 2015, J. Celorico, B. Basilia, E. Casa, R. Antinopo, J. Salvador, L. Samson, R. Loberiano, N. Almanzor

Cassava production and processing in the Philippines
Workshop on Drying Optimization for Sustainable Development of Cassava Industry in Conjunction with Starch Update 2015, 8th International Conference on Starch Technology, Bangkok, Thailand, December 3-4, 2015, A. Briones

Characterization and bio-assay for larvicidal activity of *Citrus grandis (L.) Osbeck (suha)* fractionsagainst dengue vector, *Aedes aegypti*
30th Philippine Chemistry Congress, Ateneo de Davao University, Davao City, April 15-17, 2015, R. Torres

Characterization and determination of antioxidant activity of some Philippine medicinal plants
ASEAN Food Conference, SMX Convention Center, MOA, Pasay City, June 25, 2015, R. Torres

Country report- Energy scenario, key challenges and policy initiatives for energy efficiency and conservation in the Philippines
Workshop on Advanced Energy Technologies in the Manufacturing Sector, Jakarta, Indonesia, June 1-5, 2015 A. Briones

Development of disposable cutleries from biodegradable nanocomposites
ASEAN Food Conference, SMX Convention Center, MOA, Pasay City, June 25, 2015, M. Paglicawan, C. Emolaga, MT. Navarro, P. de Yro, D. Marasigan, R. Cerbito, B. Basilia

Energy management and emerging innovative technologies
Industries for a Clean Environment, An Environmental Forum for Industries in Celebration of Environment Month 2015, NYK Compound, Calmelray Industrial Park I, Canlubang, Calamba, Laguna, June 30, 2015, A. Briones

Establishment of a food safety system for traditional Philippine *sorbetes* in some cottage to small-scale manufacturers
ASEAN Food Conference, SMX Convention Center, MOA, Pasay City, June 25, 2015, L. Montevirgen, R. Prospero, A. Flores, M. Manalo, G. Diopol, E. Almazar

Extruded corn grit and rice grain curls blended with okara
ASEAN Food Conference, SMX Convention Center, MOA, Pasay City, June 25, 2015, MP. Azanza, C. Cabigas, F. Gascon

Improved food safety system for peanut *(Arachis hypogea L.)* butter manufacture in the Philippines
ASEAN Food Conference, SMX Convention Center, MOA, Pasay City, June 25, 2015, L. Montevirgen, G. Diopol, C. Cortado, B. Flores

PCR-based detection adulterant papaya seeds in black pepper *(piper nigrum L.)*
ASEAN Food Conference, SMX Convention Center, MOA, Pasay City, June 25, 2015, E. Panerio, MD. Villaseñor, R. Esguerra

POSTER PRESENTATION

Application of nanotechnology in providing potable water
Proceedings of the 14th ASEAN Food Conference, SMX Convention Center, Mall of Asia, Pasay City, June 24-26, 2015, J. Celorico, B. Basilia, E. Casa, R. Antinopo, J. Salvador, L. Samson, N. Almanzor

Atmospheric corrosion exposure study of carbon steels in the Philippine environments
Proceedings of the International Symposium on Atmospheric Corrosion in Asian Area-JSCE Materials and Environmental 2015, Tokyo, Japan, May 18, 2015, A. Monsada, M. Margarito, L. Milo, E. Casa, R. Loberiano, B. Basilia, J. Zabala, A. Maglines, S. Harada, T. Shinohara

Comparative study of dry and wet processing of coffee
ASEAN Food Conference, SMX Convention Center, MOA, Pasay City, June 25, 2015, R. Gomez, C. Bilbao, K. Sotelo, D. Chang, N. Aidasani, MD. Villaseñor

Conduct of proficiency testing scheme for benzoic acid in fruit juice: A tool to improve accuracy and traceability of chemical measurements of Philippine testing laboratories
ASEAN Food Conference, SMX Convention Center, MOA, Pasay City, June 25, 2015, B. Ebarvia, S. Cabanilla, A. Cruz, A. Dacuya

Detection of Bisphenol A (BPA) in canned sardines
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Determination of total phenolic, content and radical scavenging activity of some Philippine medicinal plants.
International Conference on Science and Ttechnology (S&T) and PhilAAST 64th Annual Convention, De La Salle University, Taft Ave., Manila, Sept 10-11, 2015, R. Torres, C. Manalo, E. Manongsong, E. Arrogante, R. Estrella, E. Lanto

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Proceedings of the 14th ASEAN Food Conference, SMX Convention Center, Mall of Asia, Pasay City, June 24-26, 2015, M. Paglicawan, C. Emolaga, M. T. Navarro, P. de Yro, D. Marasigan, R. Cerbito, B. Basilia

Development of green composites using alkali-treated abaca fibers and polylactic acid
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Development and shelf-life study of dehydrated asparagus trimmings
ASEAN Food Conference, SMX Convention Center, MOA, Pasay City, June 25, 2015, L. Montevirgen, ME. Falco, J. Ocasla

Effect of *Piper nigrum* extracts on the duration of egg, larval and pupal development stages of *Aedes* mosquitoes
17th Anniversary, 13th University S & T week and 6th MMHRDC Anniversary Research Summit at the Unilab Bayanihan Center, Pasig City, Feb 26-27, 2015, R. Torres, A. Garbo, R. Walde

Establishment of a food safety system for traditional Philippine *sorbetes* in some cottage to small-scale manufacturers
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Establishment of processing methods for the production of natural sweetener from nipa sap *(Nipa Fruitcans Wurmb)*
ASEAN Food Conference, SMX Convention Center, MOA, Pasay City, June 25, 2015, N. Ambagan, C. Villaruz, R. Belandres, O. Evangelista, E. Magora

Expanding the role of advanced testing laboratories in the Philippines
Proceedings of the Metallurgical Engineering Conference 2015 (METCON 2015) L'Fisher Hotel, Bacolod City October 23-24, 2015, B. Basilia

Evaluation of quality profile and functional properties of *makapuno* (ECM and *kabuwig*)
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Fabrication of biomass fired steam kettle for the production of concentrated coconut water as intermediate material to coconut beverage
ASEAN Food Conference, SMX Convention Center, MOA, Pasay City, June 25, 2015, ME. Falco, M. Valdecanas, M. Manalo, M. Espena, L. Pacatang, R. Barcala, A. Tria, E. Chavez, H. Cana, M. Adulta

Fatty acid grafted coir dust as oil spill absorbent
37th NAST Annual Scientific Meeting, Manila Hotel, July 8-9, 2015, A. Briones, A. Mallillin, C. De Vera, C. Mendoza, A. Monsada

Improved food safety system for peanut (*Arachis hypogea L.*) butter manufacture in the Philippines
ASEAN Food Conference, SMX Convention Center, MOA, Pasay City, June 25, 2015, L. Montevirgen, G. Diopol, C. Cortado, B. Flores

POSTER PRESENTATION

Influence of nanoparticles on the properties of bionanocomposites from cassava
Proceedings of the 30th Philippine Chemistry Congress, Ateneo de Davao University, Davao City, April 15-17, 2015, M. Paglicawan, C. Emolaga, MT. Navarro, J. Celorico, B. Basilia

Larvicidal activity of *Persea americana mill* (avocado) against dengue vector, *Aedes aegypti*
82nd NRCP General Membership Assembly held at PICC, Pasay City, March 11, 2015, R. Torres, A. Garbo, R. Walde

Leaching kinetics of copper from printed circuit board (PCB)
Proceedings of the Metallurgical Engineering Conference 2015 (METCOM 2015), L' Fisher Hotel, Bacolod City, October 23-24, 2015, P. de Yro

Microbiological quality and safety of ready-to-eat spaghetti stored under room temperature
ASEAN Food Conference, SMX Convention Center, MOA, Pasay City, June 25, 2015, M. Manalo, J. Alejo, A. Flores, C. Cortado, U. Dollete

Performance comparison of wooden crates and corrugated box in the distribution of solo papaya from Mindanao to Metro Manila
D. Tañafranca, E. Nolasco, E. Orendain, F. Victoria

Pre-treatment of Philippine *Citrofortunella microcarpa*: Effects on the yield and properties of dietary fiber
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R. Hagos-Bonto, M. Yee, E. Dizon

Quality changes in VCO produced by centrifuge process during storage
R. Gomez, E. Luis, R. Rumbaoa, ML. Francisco

Scorching control in rice bran microwave drying
MP. Azanza, ME. Obile

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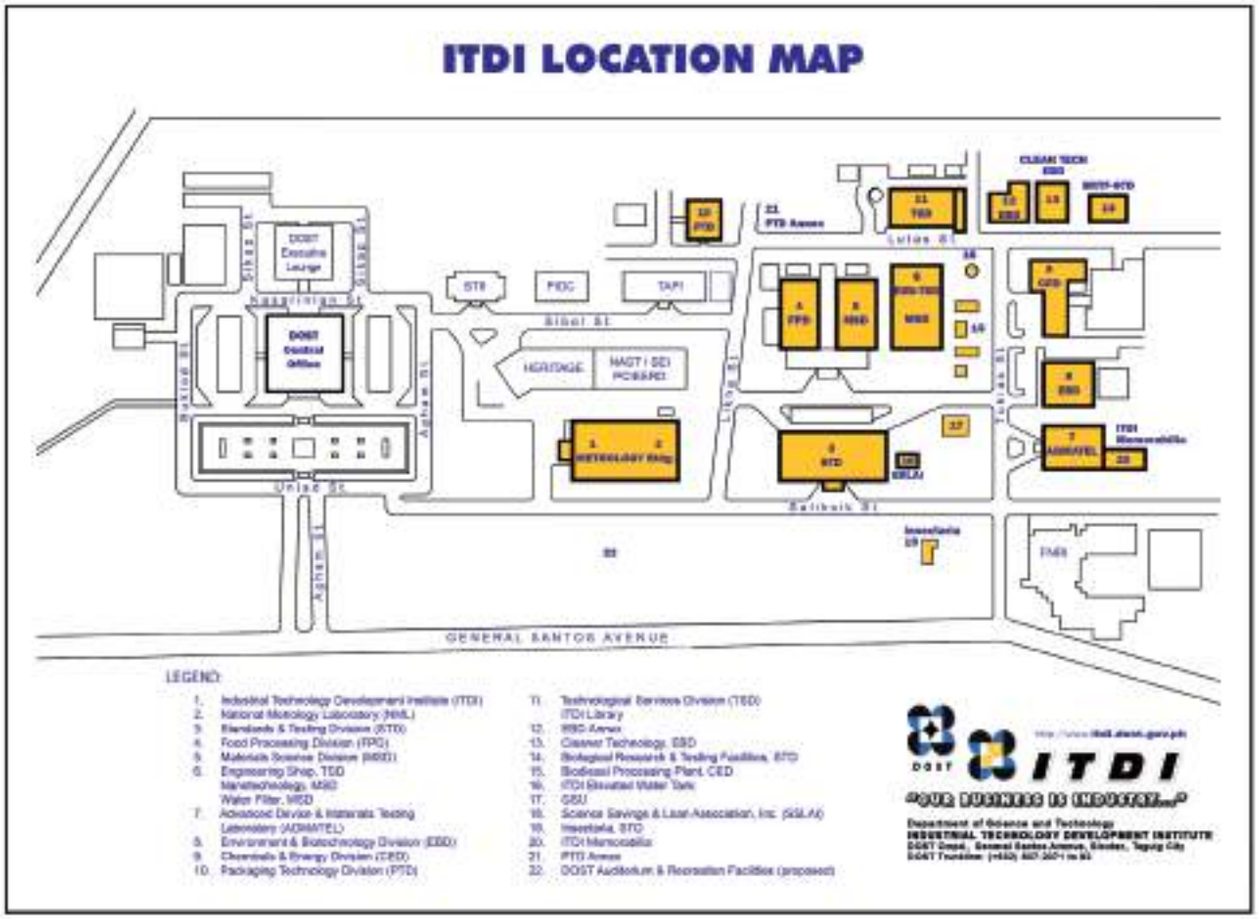

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