

# Boosting Thailand's Food and Feed Industry

## The Food and Feed Innovation Center

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Thailand is a world leader in the production and export of agricultural and food products. Its agricultural industry is a major economic engine which employs 40% of the country's labour force. Its sizable food-processing industry also contributes significantly to economy, with exports of over USD32 billion in 2011.

To continually enhance Thailand's strengths in the food industry, Thai research institutes and companies have relied on innovations to bring the sector forward. The National Center for Genetic Engineering and Biotechnology (BIOTEC) has been at the forefront of research in food biotechnology. BIOTEC is planning to establish the Food and

Feed Innovation Center, which is expected to open in mid-2013, to consolidate its core capabilities in food biotechnology under one roof.

The development of the new center builds on existing competencies in BIOTEC. It will tap upon BIOTEC's advanced discovery research in enzyme technology and gene

expression systems. It will also have access to the rich and diverse bioresources at the BIOTEC Microbe Bank, which is part of the Thailand Biological Resource Center, located in the same research complex. The brand new facility, to be located in the Thailand Science Park, will be equipped with a 300L submerged fermenter and a 100 kg solid state fermenter. Furthermore, the facility will be able to handle various downstream processes. The center will conduct research on process and product development to meet the needs of the Thai food industry. It will build up strong capabilities and develop key technologies in various areas including food safety, food chemistry, starter culture, animal feed and feed supplements.

## Food Safety and Risk Assessment

Foodborne bacterial pathogens are a concern in the food industry worldwide. As Thailand is a leading food producer and exporter, it has long established strong research capabilities in the area of food safety and risk assessment to support the local food industry.

The work of BIOTEC researchers in this area is focused, but not limited to quantitative microbial risk assessment (QMRA) on traditional food as well as high value commodities. For instance, they have studied *Staphylococcus aureus* and its toxin in fermented pork sausages, *Salmonella* spp. in broiler chicken, and *Vibrio parahaemolyticus* in frozen shrimps. By combining mathematical biology with experimental science, researchers aim to deliver applicable solutions to the industry, with the objective of removing pathogens from the food chain and indirectly, generating healthcare savings for the society.

## Food Chemistry

Biochemical and chemical changes in food components that result from processing and improper storage can greatly affect the quality of food products (e.g. texture, colour, and taste). Food manufacturers often have to cope with problems associated with such changes. BIOTEC researchers have been supporting the local food industry

by studying how major components of food interact and developing solutions for improving the quality of Thai food products.

Furthermore, with meat and meat products (including pork, chicken and shrimp) being among Thailand's top export commodities, BIOTEC researchers are working with the meat industry to improve the quality of meat. They are studying the effects of animal breeding on physical properties, chemical compositions and muscle structure of meat produced from animals reared in various production systems. This will help

the industry develop guidelines that can be applied in crossbreeding programs and meat production systems, to produce better quality meat.

## Starter Culture Technology

Thailand's fermented food industry is valued at almost USD 600 million and is growing at 10% annually. Major products from the industry include fish sauce, fermented



soybean, fermented pork sausages and pickled cabbage. The use of starter culture in the industry is important because it ensures consistent product quality and safety.

BIOTEC researchers are highly experienced in developing starter culture technology for Thai fermented foods. One example is Nham, a fermented pork sausage in which the fermentation process is initiated by lactic acid bacteria. Researchers screened various bacterial strains based on their fermentation characteristics, acid production as well as the flavour and aroma of the resulting product. They also developed a starter cell drying technology which helps to extend the shelf-life of the starter culture and allows for convenient transportation. When stored between  $-20^{\circ}\text{C}$  to  $4^{\circ}\text{C}$ , the shelf-life of dry starter cultures is more than 10 months.

Work is continually being done in this area and BIOTEC researchers are looking to enhance starter culture technology by using mathematical modelling to better control

the fermentation process, developing new screening tools, and finding better ways to monitor starter culture growth.

## Animal Feed and Feed Supplement

Feed is an important factor in livestock production. For example, the presence of non-starch polysaccharides and natural anti-nutritional factors in feed can constrain both commercial and intensive animal farming because the animals cannot properly digest the feed, leading to lower animal productivity.

The use of microbial enzymes as a feed supplement to enhance nutrient availability is becoming more common and it has the potential to increase animal productivity. However, commonly used enzymes in Thailand have to be imported. In addition, there are no specific enzymes that are being produced to enhance the nutritive value of

feed ingredients commonly used in Thailand.

Currently BIOTEC researchers are working on the application of enzymes and beneficial microorganisms as feed additives. For instance, they are screening for suitable microorganisms gathered from various locations in Thailand. They are also optimizing the production process of the microorganisms using high cell density approaches. These microorganisms may potentially be used as better sources of nutrients for various livestock (e.g. shrimps). Past collaborations with the industry have produced feeds that have allowed livestock to grow faster, get sick less often and enjoy lower mortality rates.

The Food and Feed Innovation Center is a major initiative that aims to bring BIOTEC closer to the industry. It will facilitate more effective interactions between BIOTEC researchers and their industry peers, allowing for closer and more fruitful collaborations between the two, thereby benefitting Thailand's food industry.



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## Some Success Stories

### Fermented Animal Feed

BIOTEC researchers developed a technology to produce fermented feed using grains and *Bacillus subtilis*, a microbial strain screened from the BIOTEC Culture Collection. The fermented feed is easily digested by animals because some of the nutrients are partially broken down by the bacteria and more readily utilizable by the animals. Animals fed with the feed produced better yields and meat quality. The new technology led to the setting up of Micro Innovate Co., Ltd, which is Thailand's first industrial-scale microbial production plant. The fermented animal feed is now commercially available under the trade names "B-Soy Digest" and "DS-1".

### Feed Enzyme from Local Microorganism

BIOTEC researchers discovered that the *Aspergillus niger* fungi is capable of producing several enzymes, in particular – pentosanase. This enzyme can be used to break down non-starch polysaccharides in animal feed. This allows animals to absorb and utilize more nutrients, resulting in better animal health and greater meat yield. Furthermore, the harmless fungi can perform effectively at 39.5°C and at pH of between 3 and 6.8 – conditions which are similar to those found in the stomach and small intestines of livestock such as pigs. Pentosanase was found to outperform imported enzymes when used as feed additive. The technology to produce pentosanase from *Aspergillus niger* as feed enzyme was licensed to Asia Star Animal Health Co., Ltd. The company subsequently licensed an improved version of the technology. Two products: A-Zyme and PentoZyme, are currently available in the market based on the two licences from BIOTEC.

### Accelerated Fermentation Process with Enzymes

BIOTEC collaborated with Thai Fishsauce Factory (Squid Brand) Co., Ltd. to develop a technology to reduce the fermentation period for producing fish sauce. By introducing selected enzymes, the fermentation period for fish sauce was reduced from 18 months to 11 months. Although the taste of the fish sauce from this new process was maintained, it had a milder smell compared to the original. This made the new sauce more suitable for the younger Thai generation and foreigners who prefer a milder fish sauce. The company has since been exporting this new fish sauce.

## About the Authors



Dr. Wonnop Vissessanguan is the Director of Food Biotechnology Research Unit, one of the research units under BIOTEC. He obtained his doctoral degree in Food Science and Technology from Oregon State University, USA. His main research interest is on food chemistry focusing on food proteins and enzymes that affect on quality of food products. He has published over 150 papers in internationally peer reviewed journals. Wonnop was the recipient of the 2003 Outstanding Young Scientist Award from the Foundation for the Promotion of Science and Technology under the Patronage of His Majesty the King and the 2005 Taguchi Prize for Outstanding Research Achievements by a Young Scientist in the Field of Biotechnology from the Thai Society for Biotechnology.



Dr. Lily Eurwilaichitr is the Director of Bioresources Technology Unit and Deputy Director of BIOTEC. She completed her PhD at the Research School of Bioscience, University of Kent at Canterbury, on Molecular Genetics in yeast. In 1996, she started her career as a researcher at BIOTEC and became Head of the Enzyme Technology Laboratory in 2004. One of her achievements is to lead the team to establish and develop technology for gene discovery from unculturable microorganisms from various environments. Well-known for her collaborative work with local industries, Lily has garnered several accolades, notably the 2006 L'Oreal Thailand Fellowship "For Women in Science" and the 2008 Taguchi Prize for Outstanding Research Achievement in Biotechnology. Academically, she has served as an adjunct assistant professor at Institute of Molecular Biosciences of Mahidol University since 2002 and advised/co-advised graduate students in various universities such as Mahidol University, Chulalongkorn University, Kasetsart University and King Mongkut's University of Technology Thonburi.