Merging Modern and Traditional for Better Food and Sustainability in Developing World

— Food Biotechnology Training Unveiled at CoEBio

By SONG Jianlan (Staff Reporter)

Fermentation, a traditional biotechnology invented in the early years of human history, is reborn carrying genes from modern technologies. (Photo by courtesy of Prof. Vuyst)

It might be curious for many people that the production of chocolate actually involves fermentation, a classical food biotechnology invented by humankind thousands of years ago. Traditional fermented foods, like *douchi* (Chinese fermented black beans), *gari* (fermented cassava in West Africa), yogurt and cheese, remain popular in modern societies and it is well known that many beverages including wine and beer are brewed via fermentation. Naturally, understanding and manipulating this vital process have drawn a lot of attention from the scientific community, and thankfully recent developments in basic biological disciplines like genomics, have given renewed momentum to the research of new methodologies to program this subtle process aimed at better foods with better quality and safety.

To help developing countries get the most and the best from this merging of the new and old, and to spread the valued knowledge resulting from it, a training course along the theme "Classical biotechnology (Fermentation) and Genomics for new and improved food products", was launched on Nov 30, 2013 in Beijing, welcoming about forty scientists from 18 brother countries of the developing world.

It marks the first round of a serial training on food biotechnology organized by the CAS-TWAS Centre of Excellence for Biotechnology (CoEBio, for more see page 249), which is hosted by the CAS Institute of Microbiology (IMCAS). The training, sponsored by TWAS and CAS, will unfold in three consecutive years, highlighting different themes: the course in 2014 will be given revolving "Modern Biotechnology (Genetic Engineering) and Synthetic Biology for new and improved food products", and in 2015 the course will focus on "New (Fermented) Food products based on Local Produce (Suitable Cultures, Suitable Substrates)". Open to scientists working in high affinity to food technology in all developing countries, these training courses are expected to initiate and stimulate relevant research & development in the developing world.

The first round of the training, occurring from Nov 30 to Dec 4, featured a sandwich structure combining seven half-day training sessions, each comprised lectures and discussions, and a three-night workshop for "biotechnology in practice". Eight internationally renowned scientists/experts with comprehensive food biotechnological knowledge were invited to give lectures. The topics ranged

At the brief opening ceremony, Prof. FANG Xin, OWSD President, TWAS Member and Member of CAS Presidium passes certificates to the lecturers for the 2013 Food Biotechnology Training Course. (Photo by SONG J.)

Prof. Luc De Vuyst from Vrije Universiteit Brussel introduces how his new approach can improve the fermentation process of cocoa beans through analyzing and optimizing the microbial biodiversity and developing suitable starter cultures. (Photo by SONG J.)

Lecturers with OWSD President FANG Xin (first right). From left to right: Co-Chair of the training Prof. Jeroen Hugenholtz, Corbion Purac; Prof. Dr. Roland Siezen, Radboud University Medical Centre; Prof. Luc De Vuyst, Vrije Universiteit Brussel; Prof. HAN Beizhong, China Agricultural University; Prof. ZHU Yang, Eurasia Agrofood Biotech; Dr. Wilbert Sybesma, Nestlé; Dr. Arno Wegkamp, NIZO Food Research; Prof. Filipe Santos, University of Amsterdam. (Photo by courtesy of CoEBio.)

from novel methodologies involving emerging technologies like omics aimed at improved bacterial biodiversity for fermentation, to analysis of industrial cases; and experiences from industrial practice of food giants like Nestlé Company from Switzerland were also shared in the classroom. Some lectures also dealt with the sustainable production of food as well as food ingredients.

"Interesting and Useful"

The first training session was focused on the topic "Omics for better insight and improvement of classical, tropical fermentations". In this session Prof. Luc De Vuyst from Vrije Universiteit, Brussel introduced a novel approach to analyzing the microbial biodiversity and developing suitable starter cultures for better fermentations, convincingly illustrating his new methodology with intriguing application cases in cocoa bean and sourdough fermentations.

"Belgium produces the best chocolate in the world," said the lecturer in an exaggerating tone explaining the reason to choose his first case. But obviously his methodology appealed to the audience for some other reasons.

"I like the lecture," commented Oriola Olasunkanmi Bukola, a visiting PhD student at IMCAS from Nigeria, where cocoa is an important industrial crop. According to her, Nigerians favor a kind of chocolate based on a unique way of fermentation evolving from their own history of food making. "We might be able to improve the flavor of our own chocolate using his methodology — it is interesting!" Gladly she continued: "Moreover, the methodology not only applies to cocoa beans, but also other fermentation processes."

Noting that the training course covered extensive areas from basic biological methodologies like "omics" — novel technologies derived from latest advances of genomics and proteomics *etc* — to practical experiences from industry, one might wonder whether it would be useful for scientists who tend to focus on certain specific topics of research. According to the participants, however, all the lectures are very useful. "They are all useful for food researchers," commented Dr. Adewale O. Obadina, a food safety & quality expert from the Department of Food Science & Technology, College of Food Science & Human Ecology of Nigeria: "You have to understand the basic things, like the process of fermentation to further your research targeting practical issues popping up from food production." Particularly he was anticipating the lecture given by Dr. Wilbert Sybesma from Nestlé, Switzerland: "Nestlé has some factories in my country, but I do not know they are doing any fermentation there, in my homeland," he explained.

The lecture on cocoa bean fermentation intrigued the audience and aroused questions and long discussions. Dr. Adewale O. Obadina, a food safety & quality expert from the Department of Food Science & Technology, College of Food Science & Human Ecology of Nigeria is shown in the Q&A session. (Photo by SONG J.)

From the Community, for the Community

Aside from the lectures targeting practical issues, the workshop labeled as "Biotechnology-in-practice" represented an even more practical side of the training.

Before coming to Beijing, participants were encouraged to prepare mini-proposals at home, each describing a practical issue in local food production, with potential biotechnological solutions, disadvantages and drawbacks given. After the initial round of selection, initiators of the ten best ideas were given five minutes each to present their mini-proposals, and from them three were chosen by a jury as topics for the group work, after consideration of their extent of urgency, innovativeness, social impact and feasibility.

At the workshop, participants spent two nights building on the chosen three initial ideas, enriching them with clearer research and business plans that could be turned into application. Eventually, initiators of the top three proposals were given 15 minutes each to present the results from their brain-storming. The proposal targeting a practical issue in the fermentation of cocoyam into flour and the use of cassava in making "*pupuru*", a local food based on cassava fermentation, outstood itself from peers and won further support for future R&D.

"I did not expect that the workshop could have turned out so successfully," remarked Prof. LI Yin, head of CoEBio: "I am so happy to see so many interesting and innovative ideas contributed by the participants. Furthermore, after kinda 'fermentation' of group work the workshop has yielded a highly promising and practical proposal that deserves further exploration. Not only my research group, but also those led by the lecturers from Belgium and the Netherlands have expressed the willingness to support further R&D for proposed research on cocoyam fermentation and cassava fermented '*pupuru*'." He went on: "This heralds a new wave of networking, and has also inspired our agenda setting for future training." According to LI, the other two proposals among the top three would also receive some kind of support, from research instructions, to bacteria strains for experiments.

Many participants have expressed their happiness to attend the future rounds of training. Moreover, some participants have invited CoEBio to hold training courses in their home countries, or the lecturers to give lectures there, according to LI. "I take it a nice way to recognize the training. This is also beyond my expectation."

Cassava (upper) represents a crop critical for food security in most Sub-Saharan African countries, but it decays easily and leads to serious post-harvest loss. Aimed at reducing the post-harvest loss of similar crops, including cocoyam (lower), by improving the spontaneous fermentation of cassava "*pupuru*", the proposal initiated by Dr. Adewale O. Obadina outstood itself from other competitive ideas at the workshop and won further support by the lecturers of the training. (Photos by courtesy of Dr. Obadina)

Aiming at Food Security and Sustainability

The training is also expected to help address food security and sustainability in the developing world.

In her opening remarks, Prof. FANG Xin, President of the Organization for Women in Science for the Developing World (OWSD) and Member of CAS Presidium emphasized the role of science and technology, particularly biotechnology in addressing the issue of food security. "The rapid development of economy and growth of human population in the past decades has brought about huge pressure on the global climate, environment and natural resources. The pressure is especially big for the developing countries, which suffer from limited availability of food, water, cultivable land, energy resources, eco-environmental pollution and lack of capacity to deal with these challenges," she commented, and pointed out that to achieve a better quality life and sustainable development, the developing world must rely on science and technology plus other social actions and plans. "Through science and technology, particularly the application of biotechnology, we will be able to provide better food with better quality and safety," she reiterated.

"Fermented foods can play a vital role in meeting global food needs," Prof. Romain Murenzi, Executive Director of the World Academy of Sciences (TWAS) — for the advancement of science in developing countries commented in his opening remarks for the training, which was announced by CoEBio Director, Prof. LI Yin at the opening ceremony. "And yet, research tells us that today in developing countries, the use of advanced biotechnology for food production is uneven. We can do more — we *have to* do *much* more — to meet the needs of healthy populations over the next four decades." Further, he expressed the commitment of TWAS to meeting this challenge via promotion of science advancement: "We need to continue to build understanding about the processes of food fermentation. We need to improve those processes and move beyond historic methods of production. New technologies must be evaluated for their power to increase capacity, especially at the local level."

Concerning the issue of food security, the developing world is facing great challenges. Many developing countries, especially the world's least developed countries, lack technological infrastructure and knowledge to increase their capacity. In terms of biotechnology for fermented foods, these countries might lack laboratories and equipment for advanced basic research like genomic research and enzymology, while the Internet and communication technology are insufficient for the analysis, storage and sharing of data. It takes long-term effort and commitment to substantially improve the situation, so that all nations can enjoy the benefits of scientific advances.

"This Centre of Excellence course is a reason for optimism," affirmed Prof. Murenzi.

A group photo of the lecturers and trainees, together with OWSD President, officials from TWAS ROESEAP and the CAS Bureau of International Cooperation, and leaders of CoEBio and its host institute. (Center: OWSD President FANG Xin; ninth left: Director of TWAS ROESEAP Mme FU Shuqin; tenth left: IMCAS Director LIU Shuangjiang; seventh left: IMCAS Deputy Director-General DONG Xiuzhu; ninth right: Director of Division of International Organizations under CAS Bureau of International Cooperation WANG Zhenyu; and first left: CoEBio Director and Chair of the training course LI Yin.) (Photo by courtesy of CoEBio.)