Converting Mango Waste Into Valuable Products

University of San Carlos

Every day, thousands of tons of mango peels and seeds headed to open dumpsites in Evelyn Taboada's home province of Cebu in the Philippines. And she knew it. Left to rot, the mango waste piled high in dumpsites released foul odors and attracted disease-carrying insects — a problem compounded by local residents who scavenge the sites, creating a significant health hazard.

> *"When I visited the dump site for the first time I was so disappointed to see children scavenging and eating the seeds and peels," said Dr. Taboada, professor of Chemical Engineering at the University of San Carlos (USC). "I thought, what can I do?"*

As the director of the university's BioProcess and Engineering Research Center (BioPERC), Dr. Taboada had a team of

researchers and an advanced laboratory focused on solid waste and energy at her disposal. So she and colleagues Dr. Camila Flor Lobarbio and Francis Dave Siacor, launched a BioPERC project to develop biochemical processes to convert the organic waste into commercially viable ingredients.

To help commercialize the mango waste conversion process, USC established a joint venture with a local investor and alumnus of the university to create a startup company, Green Enviro Management Systems (GEMS), which has exclusive license to use the technology across a wide range of applications in food, pharma, personal care and energy.

Today, seven mango producers in the Cebu province divert their mango waste to GEMS, which built a 2,500 square meter mango waste processing facility in 2012 to convert the refuse into flour, fuel and other products. The innovation has boosted the local economy with the creation of additional jobs and eliminated a dangerous health hazard created by the fetid, open-air waste.

When the waste arrives at the GEMS facility, it is placed in a solar drying area where seeds and peels are laid on racks to dry under a transparent roof. Next, the peels are separated from the kernels and workers remove the seed kernel's hard shell, or husk, and sort the inner kernels by quality. The fresher kernels are ground into a naturally gluten-free flour, which is exclusively licensed to a local bakery that sells the product and uses it for vitamin-rich flour for cookies, energy bars and bread. Lower quality kernels are packaged as an additive for animal feed or as a soil conditioner.

"We have zero waste," says Dr. Taboada, who, in addition to her duties at USC, serves as Chief Technical Officer at GEMS. "The husks are sold as low-cost fuel right now but in the future, they may be a useful fiber for making furniture and or as composite material for concrete and building construction."

The dried peels are milled to a powder that undergoes BioPERC's proprietary multi-step bio-refining process to extract two high-value compounds: pectin, a gelling agent commonly used as a thickener in foods and for pharmaceutical gelatin-capsules, and polyphenols, antioxidants used in foods and nutraceuticals.

GEMS and USC researchers continue to study additional bio-refining processes and applications for the mango waste, including working with pharmacologists to test the antimicrobial properties of converted ingredients and using the natural oils in the mango kernel as an anti-aging moisturizer.

During the peak of the mango season, GEMS processes up to 30 metric tons of mango waste per day with the help of 100 employees, including many of the same people who had been scavenging at the dumpsites.

"It's great to help improve the lives of these marginalized people, who gain a sense of human dignity through their work," says Dr. Taboada. "This whole concept is attractive from an environmental and social aspect as well.

"Five years ago, technology was the most important thing to me. But now I'm interested in building an enterprise and using the technology for the good of humanity."

The project has become the model for technology transfer success, says Danilo B. Largo, Ph.D., Manager of USC's Innovation and Technology Support Office, who travels the country to help educate other universities about the benefits of academic research commercialization.

In 2012, the new USC ITSO filed its first two patents for the newly developed BioPERC mango waste conversion process. Since then, the university has filed eight additional patents related to the biochemical processing of fruit waste.

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