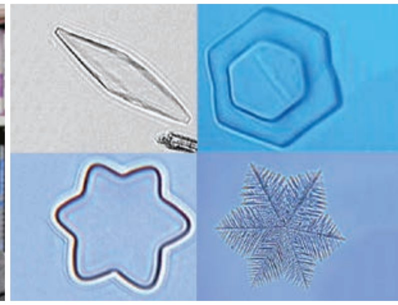

KANSAI UNIVERSITY

The next revolution in frozen food starts here

Kansai University has played a leading role in discovering, developing and commercializing natural antifreeze agents that promise to transform the frozen-food industry.

The flash freezing of fresh food makes it possible to distribute local produce around the world. Yet despite advances in flash-freezing technology, frozen foods still lack the flavour and texture of fresh produce. This degradation is caused by the enlargement of ice crystals in the critical temperature range of 0 to –5 degrees Celsius. The crystal expansion damages cell walls and causes a loss of cellular water — a process called drip loss, which has been a major obstacle for the frozen-food industry.

It has been recognized for many years that animals and plants in freezing climates have biomolecular mechanisms for preventing the freezing of cell tissue. However, isolating antifreeze proteins (AFPs) found in such organisms in sufficient quantities for commercial use remained an elusive goal until the early 2000s, when Kansai University's Hidehisa Kawahara discovered that the Japanese white radish (daikon) and its sprouts express AFP in abundance.

"In collaboration with a Japanese food company, we developed a process to extract AFP from radish sprouts in large quantities in 2009. This extract is now commercially available," Kawahara explains. "Since 2012, AFP has been used by the food industry to prepare frozen foods such as Japanese udon noodles. The amount of AFP needed is less than 0.3% by weight, so the cost of AFP is similar to that of existing food additives."

Contrary to what its name implies, AFP works not by lowering the freezing temperature but by latching neatly onto the edges of ice crystals to prevent crystal growth. Unfortunately, like many natural proteins, AFP is easily degraded by heat and acid, limiting its application in the food industry.

> **"This Japanese technology is world leading. Kansai University is the only institute for research and development in this field in Japan."**

Searching for another solution, scientists discovered in an Arctic beetle a heat- and acid-resistant lipopolysaccharide called xylomannan with the same function as AFP. Although promising, xylomannan from this source could not be isolated efficiently, preventing its commercial development. In 2014, however, Kawahara and his colleagues identified high levels of xylomannan in the commonly eaten enokitake Japanese mushroom, and the team has already industrialized its extraction.

"Xylomannan from *enokitake* promises significant quality improvement for frozen deep-fried foods," says Kawahara. "We can now produce frozen omelettes and certain types of frozen processed seafood, which was not possible before."

Kansai University President Harushige Kusumi is justifiably proud of his researcher's achievements. "This Japanese technology is world leading. We can now produce both AFP and xylomannan in industrial quantities without genetic modification. Kansai University is the only institute for research and development in this field in Japan," he says. "Our success in this area stems from our tradition of industry–university cooperation as well as on our collaboration with industry and government in the industrialization of food science across diverse disciplines, including biochemistry, life science and biotechnology."

Recent achievements:

- **Confirmed control of ice crystals in the plane by applying xylomannan.**
- **Discovered a natural supercooling facilitating material.**
- **Studied the supercooling preservation of cells, tissues and organs.**

KANSAI UNIVERSITY

Contact

Hidehisa Kawahara
Laboratory of Natural Material Engineering, Department of Life Science and Biotechnology, Kansai University
E-mail: kawahara@kansai-u.ac.jp