Prolonging Broccoli's Shelf Life

URBANA, Ill. (U of I) — While researching methods to increase the already well-recognized anti-cancer properties of broccoli [1], researchers at the University of Illinois also found a way to prolong the vegetable's shelf life.

And, according to the recently published study, the method is a natural and inexpensive way to produce broccoli that has even more health benefits and won't spoil so quickly on your refrigerator shelf.

Jack Juvik, a U of I crop sciences researcher, explained that the combined application of two compounds, both are natural products extracted from plants, increased the presence of cancer-fighting agents in broccoli [2] while prolonging the post-harvest storage period.

"We had figured out ways to increase the anti-cancer activity in broccoli, but the way we figured it out created a situation that would cause the product to deteriorate more rapidly after application," Juvik said. "For fresh-market broccoli that you harvest, it's not too big a deal, but many of these products have to be shipped, frozen, cut up, and put into other products. Usually the idea is to get it from the farm to at least the distributor (grocery store) within two to three days.

"If we could figure out a way to prolong the appearance, taste, and flavor long after harvest and maintain the improved health-promoting properties, that's always of great interest to growers," he added.

The researchers first used methyl jasmonate (MeJA), a non-toxic plant-signal compound (produced naturally in plants) to increase the broccoli's anti-cancer potential, which they sprayed on the broccoli about four days before harvest. When applied, MeJA initiates a process of gene activity affiliated with the biosynthesis of glucosinolates (GS), which are compounds found in the tissue of broccoli and other *brassica* vegetables (such as cauliflower, cabbage, and kale).

Glucosinolates have been identified as potent cancer-preventative agents because of their ability to induce detoxification enzymes, such as quinone reductase (QR), that detoxify and eliminate carcinogens from the human body.

However, during this process, MeJA also signals a network of genes that lead to plant decay by inducing the release of ethylene, Juvik explained. "While we can use MeJA to turn on phytochemicals like the glucosinolates and dramatically increase the abundance of those helpful anti-cancer compounds, MeJA also reduces the shelf life after harvest," he said.

So the researchers tried using the recently developed compound 1-methylcyclopropene (1-MCP), which has been shown to interfere with receptor proteins in the plant that are receptor-sensitive to ethylene. They applied the

compound after harvesting the same broccoli that had already been treated with MeJA before harvest.

“Ethylene will move and bind to ethylene receptors and that binding process initiates decay. What this compound does is that it more competitively lands on the protein and binds to or pushes out ethylene,” Juvik explained. “It basically stops or dramatically slows down the decay associated with ethylene.

“The combination is good,” he said.

Like MeJA, 1-MCP is also a non-toxic compound naturally produced in plants, although Juvik said synthetic forms can be produced. He stressed that both the MeJA and 1-MCP treatments required very small amounts of the compounds.

“It’s very cheap, and it’s about as toxic as salt. It takes very little to elevate all the desirable aspects. It’s volatile and disappears from the product after about 10 hours,” he said.

The use of these treatments could make a great impact on important global dilemmas such as food security issues and health-care costs, Juvik said.

“It’s a fairly cheap way to maintain quality, but it provides a preventative approach to all the medical costs associated with degenerative diseases. These are not pills that go in and take away or change damaged tissues, but it’s a way to protect people by reducing the risk they currently have to different diseases. It won’t take it away, but it could prevent further damage,” he said.

As for its impact on impending global food security concerns, Juvik said any mechanisms that will improve people’s health, especially later in life, will benefit food security.

“We need to look at what mechanisms we can use to improve not only food security but the functioning of people later in their life spans. When you look at how much the United States spends on medical costs associated with these diseases, you see it’s a huge burden on the economy, which is the same in all countries. It basically takes away resources that could be used to improve food security,” Juvik said. “Also, promoting and prolonging food stability with quality after harvest means less waste, which is a big issue in terms of food security.”

“Methyl jasmonate and 1-Methylcyclopropene treatment effects on quinone reductase inducing activity and post-harvest quality of broccoli” was published in the October 2013 issue of *Plos One* and can be accessed online at http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0077127 [3].

Co-authors of the study were Kang Mo Ku, Jeong Hee Choi, Hyoung Seok Kim, Mosbah M. Kushad, Elizabeth H. Jeffery, and Juvik.

AgroFresh, a division of Rohm & Hass Inc., provided 1-MCP and equipment for the

study.

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