Producing Better Produce

How researchers are maintaining the quality and extending the shelf life of fresh fruits and vegetables

By Greg Tammen

ELINI PLIAKONI AND COLLEAGUES have an appetite for fresh produce production and storage research. An assistant professor of horticulture and natural resources at the Kansas State University Olathe campus, Pliakon specializes in urban food production and postharvest handling, or how the handling procedures of fresh fruits and vegetables affect these foods and what techniques safeguard their quality and extend their shelf life.

“Fresh fruits and vegetables are very diverse, so there is not one postharvest-handling approach that will work for all,” Pliakon said. “For example, tomatoes and broccoli cannot be stored at the same temperature. Because of the differences between fresh fruits and vegetables, we are required to use multiple techniques to develop different handling methods for every type of produce.”

Pliakon collaborates with Cary Rivard, assistant professor of horticulture and natural resources, extension specialist and director of the Horticultural Research and Extension Center in Olathe, Kansas, and Helena Pontes Chiebao, postdoctoral research associate in Pliakon’s lab. Pliakon also leads a team of three graduate students who conduct research on various fruits and vegetables.

The researchers are focusing on a combination of tools and techniques, ranging from temperature control to low-cost greenhouse alternatives, to maintain taste and nutrition while extending the shelf life of fresh produce grown by smallholder Kansas farmers.

Small-acreage farmers have fewer than 10 acres of land and represent more than half of the vegetable producers in the Midwest. Helping smallholder farmers increase the...
availability of locally grown, fresh fruits and vegetables in metropolitan areas is important for several reasons, Plakouti said. Urban populations are continuing to grow. Also, growing consumer interest in locally produced food and farmers markets, which account for more than $6 billion in annual sales. Even more pressure will be placed on local food systems as the world’s population balloons to a projected 9.6 billion people by 2050.

No ‘one size fits all’

The Kansas State University researchers work with Kansas-grown broccoli, asparagus, beets, spinach, tomatoes, melons and sweet potato slips. Producers are grown on a university research farm, then harvested and transported to the lab for study in KoolKat, a trailer turned into a mobile refrigeration unit. The trailer can keep food cooled to as low as 35 degrees Fahrenheit, which reduces losses of temperature-dependent foods.

'Vee one-size-fits-all' approach to production handling, project often involve multiple tools and techniques, Plakouti said. For example, a completed Kansas Department of Agriculture-funded project had researchers looking at how a combination of ozonated water wash and modified atmosphere packaging — packaging that produce grown in high tunnels has a longer shelf life, microflora, while the modified atmosphere packaging extended the shelf life of broccoli, spinach and asparagus in non-optimum storage temperatures?

High tunnels

Under Rizal, one of the team’s main research focuses is high tunnels, which are long, semi-circular structures made of polyethylene that serve as a low-cost alternative to greenhouses. High tunnels greatly reduce crop height, heavy rain, hard wind and damaging storms, and they create a microclimate inside the structure. As part of an ongoing collaboration with the University of Florida, researchers have been able to prove that high tunnels boost fresh produce production. Chiebao’s part of this project is to investigate the effect of growing in high tunnels on the quality of produce. She has found that produce grown in high tunnels has a longer shelf life, which makes fruits and vegetables more marketable and adds to growers’ profits.

‘As much as 40 percent of fresh fruits and vegetables are lost from harvest to market because of spoilage, rot and other causes,” Plakouti said. “We’re seeing that produce grown in high tunnels have better quality and are more marketable than produce grown in the open field. Fruits, such as tomatoes, have fewer cracks, splotches and other aesthetic defects.”

Agricultural engineering students at the University of Florida are developing a prototype low-cost treatment device that farmers can use on spinach and tomatoes in the field. Once developed, it will be reproduced at Kansas State University and used for research as well as for demonstrations. As part of the project, Rizal is working with a consultant and software developer to make a smartphone app that will help growers and extension agents keep track of locally grown crops, identify what is causing a crop loss, and adjust what crop is planted and when so that growers can maximize their food production.

Modified atmosphere packaging

Batziakas also is working with modified atmosphere packaging. Modified atmosphere is the practice of changing the composition of the internal atmosphere of a produce bag to maintain the quality of the produce inside and extend its shelf life. Typically the bags are flushed with a gas mixture that has decreased oxygen and elevated carbon dioxide content. Bags are produce-specific and designed for a specific optimum temperature. “The problems with this type of packaging is that it is designed only for a certain temperature,” Plakouti said. “If leafy greens are processed and packaged at 40 degrees Fahrenheit, they then travel in a refrigerated truck to a distribution center, then to a grocery store and then onto the store shelves. The cold chain is disrupted in many of those steps, and you can imagine how big the temperature fluctuation is throughout that journey. That makes it challenging to design a singular package that adjusts to the different temperatures and remains beneficial.”

Researchers on the Agriculture and Food Research Innovative project are working on a possible solution: improving the storage efficiency of this packaging by determining proper atmospheric conditions for the produce kept in ambient temperatures. They are storing spinach in commercial bags in above-optimum temperatures to identify possible improvements. The researchers then plan to collaborate with a packaging company to manufacturer a better packaging solution for spinach kept at ambient temperatures.