

Improving Western Vegetable Quality

Vegetable production, harvest, handling and fresh-cut processing

by Joanne Littlefield



Jorge Fonseca

Grocery stores respond to consumer demand for fresh-cut produce with an expanding array of packaging.



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Work in the lab includes examining different packaging materials and how to help manage shelf life of produce.

The produce section in your local grocery store is continually expanding the shelf space it devotes to cut and pre-packaged fresh fruits and vegetables. No longer satisfied with the canned and frozen food lifestyle, Americans demand convenience, safety and top quality in the fresh produce they buy. University of Arizona researchers are helping the produce industry respond to this need by testing ways to assure the freshness and nutritional content of fresh produce while guarding against microbial contamination.

“Several disease outbreaks have been linked to vegetable consumption during the last decade,” says UA plant physiologist Jorge Fonseca. Although most were due to cross-contamination (such as putting vegetables in contact with raw meat), studies show that pathogens can grow in produce, and high microbial loads can make people sick. “Since many vegetables are consumed raw, we want vegetables free of pathogens and with a low microbial population in general.”

Fonseca is responsible for the Western Vegetable Quality Assurance Program, created when he joined the plant sciences department in the UA College of Agriculture and Life Sciences in 2003. He is based at the Yuma Agricultural Center, in the heart of one of the nation’s major vegetable production areas. The 274-acre farm includes a diversified range of crops, including cotton, small grains, and such vegetables as lettuce, broccoli, melons and others. Growers in the Yuma area raise cool weather crops such as lettuce for the fresh market and for processing in packaged salad mixes, as well as a number of cole crops such as broccoli, cauliflower and cabbage. Warm weather crops include a variety of melons. Depending on the time of year, Fonseca could be out in the field studying

the increased nutritional value of crops grown with seaweed extract, for example, or working in the lab examining different packaging materials and their contribution either to extending shelf life or accelerating decay.

“I did some work in the past with fresh-cut watermelons; they are one of the exceptions that do not hold well,” Fonseca says. “They start fermenting very rapidly after the oxygen drops below 14 percent in the atmosphere. So to package fresh-cut watermelon you need very high permeability films or plastics, whereas some types of lettuce can be stored at below one percent of oxygen and they will do fine.” He found that lettuce does not do well in packaging that allows for a high carbon dioxide buildup because the leaves will start to turn yellow. Fonseca relays his findings on post-harvest plant respiration to plastic film manufacturers so that a precise packaging material can be developed for different fruits and vegetables. “My intention is to continue doing this type of work with commodities we don’t know much about,” Fonseca says.

As a post-harvest specialist, Fonseca is interested in the nutritive value of fruits and vegetables at various stages after harvest. Vegetables grown in the Sonoran Desert are exposed to a greater amount of light than in other regions, such as California’s Central Valley and vegetable-growing areas on the East Coast. The particularly high levels of salt in the Yuma area soil are also unique in the desert. Factors like this can influence both the nutritional content of vegetables and their “nutraceutical” value, which refers to the potential of nutrients and phytochemicals in plants to help prevent disease. Fonseca says, “We’ve observed that cultivation with

UV reflective mulches provide more light to the plants.” Those films reflect approximately 30 percent of all the light upward, including UV light which may or may not be beneficial (UV light could produce stress, too). In the case of muskmelons the film yielded higher soluble solids, higher levels of vitamin C and the added benefit of increased volume yields.

Throughout his research, Fonseca contacts local growers when he thinks they can benefit from it immediately. “We do applied research here but sometimes we just want to understand why something happened so that we can tell the grower,” Fonseca says. “For instance, we can say ‘we obtained these results with the seaweed extract,’ or ‘the calcium applied two or three weeks before harvest did this’ and the grower can do it right away.”

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Beyond seeing that something is working, Fonseca wants to know why it is working, which leads him to the laboratory for analysis. Fonseca’s lab contains precision instruments that can analyze very small quantities of plant extract. He uses High Performance Liquid Chromatography or HPLC, for analyzing liquid, the gas chromatograph for post-harvest physiology analysis and a chromameter to measure color.

Another section of the lab contains machines designed to extract microbes from contaminated produce for analysis. With the HPLC, for example, Fonseca can sample just 10 microliters extracted from the pulp of cantaloupe to measure its vitamin C composition. He discovered that unlike other produce, cantaloupe actually increases in vitamin C for a short period of time following harvest. “Having the vitamin C going up during post-harvest storage (as the melons continue ripening) is good news, but what we don’t know yet is how or if mishandling plays a role. Very likely the vitamin C will eventually go down when the fruits are exposed

to excessive shock and vibration as encountered sometimes during transportation,” he says.

Back in the field, Fonseca is studying the amounts of water — through irrigation or rainfall — that may lead to increased produce contamination on lettuce. A recent educational program targeted at food handlers across the nation focuses on food safety “from the farm to the table.” In response to this, Fonseca began questioning if late irrigation or rain close to harvest might play a role in increased microbial activity in the crop.

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“I’d seen people harvesting in muddy fields which made me wonder if there was some effect of the moisture on the microbial population,” Fonseca says. To more closely match Arizona growers’ needs, Fonseca conducted his three-year vegetable irrigation trials on a commercial scale. He varied the time of the final irrigation in different plots to test the effect on yield and quality, including contamination. During winter 2005 when continual winter

rains blanketed the desert and fields, Fonseca took the opportunity to assess rainfall’s contribution to microbial activity by gathering produce samples just prior to and following the rain. He definitely found a pattern, where the lettuce that had less water had better quality. He also found that the closer the last irrigation was to harvest time the higher the microbial population, especially with sprinkler irrigation. “A grower might consider something in between, not irrigating too early and not too late,” he suggests.

Once a crop is out of the field, a spray of chlorine bleach is the current industry standard for post-harvest sanitization. Fonseca’s future work will be looking at other sanitizers that will help ensure healthier fruits and vegetables for the consumer. ✨

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