# Superior Sorter Selects Stain-Free Nuts

Pistachios with clean, light-colored shells might now be easier to distinguish from stained, lower grade nuts, says ARS agricultural engineer Thomas C. Pearson. The high-speed, bichromatic sorters popular in packinghouses today, he reports, can be augmented with "machine-vision" systems.

The system Pearson devised is about one-and-one-half times more accurate than bichromatic equipment in deciding whether a pistachio sports an attractive, stain-free shell. That's according to his preliminary tests with more than 2,000 pounds of the buttery-flavored nuts. He did the work in his laboratory at the ARS Western Regional Research Center in Albany, California, and at a California packinghouse. Two other packinghouses also contributed freshly harvested pistachios for the tests, which Pearson ran under the supervision of Thomas F. Schatzki, a chemist at the Albany center.

When an automated sorter misjudges a nut, workers further along the production line can catch the error. But correcting machine-made errors takes time. That costs money and cuts profits, despite the fact that blemished nuts usually make up no more than 5 percent of the harvest. Dark stains sometimes indicate insect damage or, rarely, the presence of the *Aspergillus flavus* mold that forms aflatoxin—a contaminant.

The machine-vision system relies on line-scan video cameras outfitted with microprocessors called DSP's, or digital signal processors. Pearson and Venitia W. Lee, formerly at Albany, wrote new software that instructs the high-tech DSP's how to interpret the images of the pistachios as they whiz past the cameras.

And Pearson created other customized software that tells a desktop computer, also part of the system, how to decide whether a pistachio has unacceptable stains on its shell. The machine-vision sorter can keep the same pace as the bichromatic sorter's impressive rate of 144,000 pistachios per hour.

A sorter outfitted with DSP's, says Pearson, peers at the nut surfaces in greater detail than a bichromatic device and sidesteps errors that the conventional sorter might make. That's because the DSP's independently analyze pixels—the pinhead-sized bits of image sent to them by the cameras.

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**For better quality nuts, an experimental machine-vision sorter removes discolored pistachios up to one-and-a half times faster than present commercial equipment. (K7504-1)**

An example: Pistachios open their shells as they ripen. A bichromatic sorter, which gauges the "average color" of a nut, might perceive an unstained pistachio as dark brown if much of the nut's brown-skinned kernel is peeping from the opened shell. When that happens, this premium pistachio ends up in the same processing line as nuts with sizable stains.

As the machine-vision sorter collects images all the way around the perimeter of that same nut, however, it finds very few regions where pixel color changes from dark to light. In this instance, pixel color changes only where the light shell borders the dark kernel. The computer, explains Pearson, determines that this pattern of few transitions from dark-to-light is characteristic of a clean, partially opened pistachio. A stained pistachio, in contrast, would have several more transitions where clean areas met with a dark stain.

Machine-vision systems that use digital signal processors are relatively new. The Albany work, according to Pearson, is the first application of this technology to pistachio sorting. He is seeking a patent for his invention.—By **Marcia Wood**, ARS.

*For more information on patent application number 08/550,310, "Machine-Vision Apparatus and Method for Sorting Objects," contact Thomas C. Pearson or Thomas F. Schatzki, USDA-ARS Western Regional Research Center, 800 Buchanan St., Albany, CA 94710; phone (510) 559-5868, fax (510) 559-5777; e-mail pearson@pw.usda.gov* ◆