FY **2010 Annual Report for National Program 306,**

**Quality and Utilization of Agricultural Products**

This National Program is focused on post-harvest quality and utilization of agricultural commodities and products. It addresses Strategic Goal 2, Objective 1, Performance Measure 2.1.2 (Develop cost effective, functional industrial and consumer products, including higher quality, healthy foods, that satisfy consumer demand in the United States and abroad) of the ARS FY 2006-2011 Strategic Plan.

Research projects in this program were terminated in 2010 or will be terminated in 2011 after redirection and/or successful peer review of newly developed projects. The accomplishments reported below reflect research accomplished by the terminating projects under the 2000-2010 (modified in 2004) national program action plan. The new projects implemented in 2010 or 2011 will be guided by a new action plan for 2010-2015.

Selected accomplishments in this national program for fiscal year 2010 are shown below under the two program components.

1. **Quality Characterization, Preservation, and Enhancement**

**Ozone fumigation controls postharvest decay of table grapes**. Table grapes rot and spoil after harvest unless actions are taken to preserve them, such as the fumigation of grape storage rooms with sulfur dioxide; however, growers of ‘organic’ grapes cannot use sulfur dioxide and need an acceptable option. Researchers in Parlier, California, evaluated ozone fumigation in Parlier and in two commercial cold storages. Ozone gas, an approved substance for use by ‘organic’ growers under the USDA National Organic Program rules, reduced rot and approximately doubled the storage life of the grapes in cold storage from 2-3 weeks to 4-5 weeks. This work provides a useful alternative method to reduce rot and extend the storage life of grapes in this industry, which produced 99 million boxes worth approximately $1,200,000,000 in California in 2008, of which approximately 5% were classified as ‘organic’.

**Commercialization of sorting technology and adoption by seed breeders/producers**. Engineers at Manhattan, Kansas, transferred a low cost color image based sorting device for grains to National Manufacturing through a CRADA. These instruments have been sold to various seed breeders and seed foundations in the U.S. and internationally. The new sorting system has unprecedented accuracy, throughput, and low cost for inspection/sorting systems. A CRADA with Jolly Time Popcorn is also in place to adapt the machine for sorting popcorn, and the camera design has been transferred to an electronics manufacturer (Short Dog Electronics). These instruments have been extensively used for separation of large bulks of popcorn, yellow and brown flax, red and white wheat, scab-damaged wheat, and removing weed seeds from seed stocks to improve quality of breeding lines and end-use products. North Dakota State University seed foundation states that the machines shortened production time for yellow flax by one year, increased production by 20%, and reduced contaminates by 90% over past practices. Other users report similar impact.

**Adapting ARS NIRS grain technology to detecting traits of disease vectors**. Engineers in Manhattan, Kansas, developed technology to measure traits of single wheat kernels using near-infrared spectroscopy (NIRS). This technique can also determine traits of single insects, such as species and age. In cooperative work with the Centers for Disease Control, Atlanta, Georgia, and the Ifakara Health Institute, Ifakara, Tanzania, the researchers showed that the technology determines mosquito species and age with about 90% accuracy. These findings have importance for monitoring control programs where species identification and reduction in the proportion of older mosquitoes that have the ability to transmit malaria is an important outcome. The technique has been adopted by the CDC and researchers in England, Austria, Australia, and Tanzania.

**Development of improved wheat germplasm**. Wheat producers, milling and baking industries, and overseas customers require high standards in the quality of wheat to meet their evolving needs. Scientists in Fargo, North Dakota, contributed wheat end-use quality data that helped lead to the development of improved wheat germplasm and subsequent release of new cultivars of spring, winter, and durum wheat bred for commercial production. The lab provided over 40 different tests related to the physical and biochemical quality traits of the wheat kernel and related milling performance, flour, semolina, dough, baking, and spaghetti processing on over 4,000 samples of hard spring, hard winter, and durum wheat lines that were submitted by public and private wheat breeders and cooperating scientists. The impact lies in the release of five experimental lines of spring wheat, which included the cultivar Brick.

**Exposure of simulated supermarket continuous light during simulated retail marketing of spinach increases vitamin concentrations**. Human health benefits derived from consuming fruit and vegetables are due to the many human bioactive compounds (vitamins C, folate, E, K, and pro-vitamin A) found in produce. However, concentrations of these bioactive compounds are heavily influenced by plant genetics and pre/postharvest environmental display shelf-life. Scientists at Weslaco, Texas, used spinach leaves from two popular commercially grown cultivars (Lazio and Samish) and placed them in plastic containers that were stored under continuous light or dark conditions. All vitamins increased in concentration with storage under continuous light and decreased under continuous dark. This research established, for the first time that, at least with spinach, the concentrations of human bioactive compounds in postharvest green (photosynthetic) tissues exposed to supermarket light levels (retail display) will increase during storage. This information should deter some of the concerns about diminishing nutritional quality of produce in retail settings.

**Moisture sensing in almond kernels**. For almonds, initial moisture content and moisture migration are critical for safe storage and the preservation of their quality attributes, and there is a need for real-time monitoring of moisture content at different stages of processing. At the request of the Almond Board of California, engineers at Athens, Georgia, adapted a microwave dielectric method, which was originally developed for grains and seeds, to rapidly predict moisture content in almond kernels. Adoption of this technology by almond growers and processors will allow them to improve the quality of almonds, avoid spoilage and waste, and maintain their position as the global market leader.

**Effect of Huanglongbing disease on orange juice flavor**. Huanglongbing (HLB), also known as ‘greening’, is a devastating disease for the citrus industry. In addition to debilitating trees, fruit quality was anecdotally reported to be affected, but no chemical or sensory studies had been done. Researchers in Winter Haven, Florida, showed that only fruit that were severely affected by the disease imparted a negative flavor to the juice. When fruit with normal appearance, harvested from HLB-affected trees were juiced, the juice flavor was not different from juice made from fruit harvested from healthy trees. It is important to the citrus processors to now know that they only need to sort out symptomatic fruit (small, green and lopsided fruit) from their processing line to maintain juice quality. Studies are now ongoing to determine threshold levels of HLB-induced off-flavors in normal juice.

**Pre-harvest sprays reduce citrus postharvest diseases**. Canker and melanose diseases cause postsharvest rejection of citrus fruit. Pre-harvest sprays of a wax emulsion combined with pesticide, applied by scientists from Winter Haven, Florida, along with industry cooperators, was successful in reducing canker bacteria and melanose fungus on citrus leaves and fruit in the field, resulting in less inoculum when the fruit entered the packing house and less postharvest decay and eliminations. The reason for the reduced pathogen load due to the pre-harvest treatment was because the wax spray allowed the pesticide to remain longer on the tree during rain events. This process reduces postharvest problems and resulted in a patent application.

1. **New Processes, New Uses and Value-Added Foods and Biobased Products**

**Starch-oil composite gel fat replacer for ground meat applications**. This technology was developed by scientists at Peoria, Illinois, and commercialized by a commercial partner and licensee, resulting in large scale production of a fat replacer gel and sales of reduced fat ground beef patties. Recently the color and flavor attributes of the gel were improved by adding clean label colorants and flavors. Use of the gels allows the conversion of 93-95% lean beef, which tends to yield a chewy and dry cooked patty, to a low-fat alternative with consistently observed tenderness, juiciness, and flavor (delivered in the lipid phase of the gel). Similar results of this technology were also demonstrated in meatballs and pork sausages. The company plans to expand the marketing of the low-fat patties to large volume institutional customers as well as broaden the product line to include emulsified meat products such as frankfurters and lunch meats. The availability of this technology, which delivers significant fat (and calorie) reduction while enhancing product quality, will ultimately enable progress in addressing consumer obesity and increasing acceptance of healthier alternatives to traditionally high fat foods.

**Commercialization of estolides as a bio-based lubricant**. There is a great demand in the U.S. and world-wide for increased development and use of biobased products. Scientists at Peoria, Illinois, developed and patented a biobased lubricant called estolides which have physical properties that can make them a leader in fulfilling demand for the increased development of bio-based lubricants in the U.S. A private sector partner has advanced commercialization, production and availability of the product to future customer/industry users. The first commercial production will take place in early FY 2011. Development of estolides will lessen our demand on foreign oil while decreasing the amounts of petroleum-based pollutants being released into the environment.

**Biobased materials in tires**. Researchers in Albany, California, in collaboration with Cooper Tire and Rubber and the National Renewable Energy Laboratory, conducted a Life Cycle Analysis comparing petroleum-based and bio-based material usage in tire manufacturing. The analysis estimated the potential impact of biobased materials technology on reducing oil dependency related to 1) raw material manufacture, 2) gasoline savings from improved fuel efficiency, 3) net energy savings associated in making raw materials, and 4) the potential impact on greenhouse gas emissions. The use of natural rubber in all tire components was premised. The analysis effectively demonstrated the positive contributions the U.S. tire industry could make toward the goal of decreasing petroleum dependency by converting from petroleum based materials to non-petroleum based materials.

**Use of cotton byproducts in bio-materials**. Expanded Polystyrene (EPS) and Expanded Polypropylene (EPP) are used to make non-biodegradable protective packaging materials, a $2.2 billion industry. Engineers at Lubbock, Texas, developed six cotton byproduct blends and mechanical processing techniques that allowed for the cooperator to manufacture 100% biodegradable packaging composites, using their technology, which outperformed EPS and EPP. The cotton byproduct protective packaging material resulting from this research allowed the cooperator to launch the product in 2010 with a Fortune 500 company and gain the interest of two other Fortune 500 companies. More widespread use of cotton byproducts is expected within the next few years.

**Commercialization of pterostilbene**. Pterostilbene is a naturally-occurring phenolic compound in blueberries and an analog of resveratrol which is the well-known polyphenol in grapes and wine. Scientists at Oxford, Mississippi, showed that pterostilbene is a more effective cholesterol lowering agent than resveratrol in laboratory animals, as far as activating a protein that plays a major role in lipid metabolism and transport. In another animal study, pterostilbene was shown to reverse memory and cognition deficits. For these activities and the potential for similar effects in humans, pterostilbene was licensed by a company (ChromaDex). Commercialization of pterostilbene under the tradename pTeroPure™ was launched in April 2010. pTeroPure™ pterostilbene is now on the market for use as a pure compound, or mixed with other natural compounds as dietary supplements. More pterostilbene products are expected to be on the market in the coming years.