**Fiscal Year 2008 Annual Report for National Program 306,**

**Quality and Utilization of Agricultural Products**

National Program 306 (NP 306) focuses on post-harvest quality and utilization of agricultural commodities and products. It addresses Strategic Goal 2, Objective 1, Performance Measure 2.1.2 of the ARS FY 2006-2011 Strategic Plan (*Develop cost-effective, functional industrial and consumer products, including higher quality, healthy foods, that satisfy consumer demand in the United States and abroad*).

In March 2008, an external panel conducted a retrospective assessment of the accomplishments and impact of NP 306 over the past 8 years based on a comprehensive accomplishments report provided to the panel by the Program management team. The team held a workshop in June 2008, inviting stakeholders to provide input on relevant problems and research needs. From this workshop and subsequent internal planning meetings, a new National Program Action Plan was developed and announced in November 2008. The development of new project plans, their peer review, and implementation in 2010 will launch the second cycle for this program.

Select accomplishments by NP 306 for fiscal year 2008 are shown below under the two Program components.

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

Sunflower cultivars with high levels of gamma- and delta-tocopherols. Studies on vegetable oils by scientists at Peoria, Illinois, showed that gamma- and delta-tocopherols were much better antioxidants than alpha-tocopherol, which is also known as vitamin E. Because sunflower oils contain mostly alpha-tocopherol, the Peoria scientists recommended that ARS plant geneticists develop sunflowers with high amounts of gamma- and delta-tocopherols to enhance the oxidative stability of sunflower oil. In March 2008, a germplasm release of this modification was made through the ARS Germplasm Resources Information Network (GRIN). This new modified sunflower oil has the potential to help replace trans fat-containing hydrogenated oils for high stability uses such as frying and to produce good quality, healthful foods.

Analytical support for soybean and other oilseeds. Soybean breeders are dependent on rapid, standardized, and accurate chemical properties to guide their breeding efforts. Oil, protein, and moisture content determinations (30,601 soybean samples by near infrared), as well as fatty acid profiles (15,089 samples), were performed by scientists at Peoria, Illinois, and the compiled data was published in the annual United States Department of Agriculture publication, “Coordinated Soybean Analysis.” All of these data have been provided to breeders throughout the United States, where the information is critical to the development of improved soybean varieties. The Peoria scientists also analyzed 100 Camelina accessions for free acid content and percent oil for breeders in Nebraska and 1,000 Brassica accessions for free acid content and percent oil in a cooperative study with the Plant Introduction Station in Ames, Iowa. In addition, more than 140 Jojoba accessions were analyzed for free acid content and percent oil for the National Plant Germplasm System. The continued analysis of accessions gives breeders the information they need to make plant selections and to monitor breeding progress.

Generation of malting quality data for Barley CAP project. The Barley CAP project is a broad, integrated project for the barley research community, involving 30 research programs from U.S. institutions, that integrates genotypic and phenotypic information in order to develop more efficient tools for barley improvement. In year 2 of the project, scientists at Madison, Wisconsin, provided phenotypic (malting quality) data on all 1,100 lines submitted by participating breeding programs. These data will be used in conjunction with other phenotypic data (agronomic, disease resistance, food/feed quality) and genotypic characterization, constituting a comprehensive data set for linking the genetic basis for phenotypic performance in a crop where a comprehensive genomic data set is not available. This will benefit researchers (understanding the linkage of genetic traits with important performance features) and growers (allowing development of malting barley varieties that meet malting quality specifications, as well as showing needed disease resistance and meeting agronomic benchmarks by eliminating existing yield penalties in malting varieties), as well as the malting and brewing industries (by providing an adequate supply of suitable quality malting barley varieties).

Chemical and sensory analyses of tomatoes. The tomato is the second largest vegetable crop in dollar value in the United States, with a fresh market value of $1.6 billion in 2005. Using chemical and sensory analyses, the 19 most important odorants responsible for fresh tomato flavor were identified and quantified by ARS scientists at Albany, California. It was shown that the differences between highly appetizing and less appetizing tomatoes were due to variations in the concentrations of certain flavor compounds. This fundamental knowledge will help plant breeders and growers to select cultivars with the highest consumer preference.

Low-cost wheat color sorter. A low-cost sorting device for wheat was built by engineers at Manhattan, Kansas, using a standard personal computer and color camera. Special programming techniques were used so that the throughput of the sorter would be high while keeping the sorter cost low. The sorting system was tested on its ability to separate red wheat from white wheat for wheat breeding programs. At a wheat throughput of 30 kernels per second, or 3.5 Kg per hour, the sorter is able to correctly separate 95% to 99% of the wheat. The accuracy is 15% to 20% higher than what can be achieved with traditional sorters. This sorter will help breeding programs isolate desirable kernels so that they can be propagated, which will result in faster releases of new and improved varieties of grain. Four wheat breeders in the United States have already adopted this system as their tool of choice for separating red and white wheat.

Automated near-infrared system for selecting individual kernels based on specific quality characteristics. There is currently no method to select kernels with specific end-use characteristics to assist breeders in developing cultivars for specific grower needs or for specific markets. Current methods of developing new cultivars require many years of repetitive crosses to attempt to develop pure lines with specific traits. Engineers at Manhattan, Kansas, developed a system that can automatically select specific kernels with specific traits from populations. The system utilizes near-infrared spectroscopy that measure attributes such as protein content, starch levels, or kernel hardness in individual kernels and then removes those kernels from the sample at a rate of about 1 kernel/2 s. These kernels can then be used by breeders to develop cultivars with specific traits that will result in crops with improved agronomic performance and improved end-use quality. Also, the selection of kernels can occur in a few minutes and does not take the years of crossing required in current breeding programs. The system can also be used to measure the variability of quality within samples, providing valuable information to grain handlers, storage managers, millers, and grain processors. The system has been applied to wheat and proso millet and could apply to other grains.

Development of improved wheat germplasm. Wheat producers, milling and baking industries, and overseas customers require continual improvement in the quality of wheat to meet their evolving needs. ARS researchers at 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. They provided more than 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 more than 4,000 samples of hard spring, hard winter, and durum wheat lines that were submitted by wheat breeders and cooperating scientists. The impact lies in the release or potential release of five experimental lines of spring wheat in 2007/2008 and the commercial release of the cultivars ‘Briggs’ and ‘Ada’ in 2007.

Potato postharvest quality evaluations and release of new potato cultivars. The ability to process acceptably after storage is an essential attribute of a successful potato variety. The standardized evaluation procedures developed and used at East Grand Forks, Minnesota, have been an important component of the overall process of evaluation and release of new cultivars by Federal and state cooperators nationwide. In support of Federal and non-Federal public breeding/screening programs, researchers at this location have analyzed between 14,000 and 15,000 advanced breeding lines for storage/processing quality annually. Research conducted in collaboration with North Dakota State University and the University of Minnesota has contributed to the release of two new promising potato varieties: Dakota Crisp and Dakota Diamond. Both varieties offer significant benefits to both producers and processors and should be widely adopted by the potato industry.

Cotton moisture sensor development. The seed cotton moisture measurement system, "SMMS", is one application of broader technology that was developed by scientists at Lubbock, Texas. As developed, the SMMS is capable of being utilized in both seed cotton moisture sensing as well as in cotton bale lint moisture sensing. This technology has produced three U.S. patents. A material transfer agreement was completed with a commercial partner in 2008 to effectively implement the transfer of the technology to industry.

Physical property database assembled and placed online. Physical property data of advanced breeding lines of peanuts have been collected as a result of collaborative tests with United States peanut breeders since 2001. The physical property data have been assembled into a searchable on-line database by scientists at Dawson, Georgia. Data can be searched based on peanut market type and growing area and downloaded for statistical analysis.

Release of two new strawberry varieties. Two strawberry advanced selections, 'Florida Elyana' and ‘Florida Radiance’, were released by the University of Florida due to collaborative efforts by ARS researchers at Winter Haven, Florida, and a University of Florida strawberry breeder to develop flavorful fruit complementing the ripening period of the current commercial variety, ‘Festival’. Strawberry advanced selections were evaluated for flavor, color, and horticultural characteristics, including sensory and chemical analyses, resulting in the development of fruit with constant superior eating quality during the ripening season of strawberries in Florida.

Breeding for good roast peanut flavor. Moisture, fat, tocopherols, sugars, fatty acids profiles, and sensory characteristics were determined on 235 samples for the Uniform Peanut Performance Trials by researchers at Raleigh, North Carolina. These data are critical in development of new peanut varieties and have been used in the development of several released lines.

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

Environmentally friendly hide dehairing process. Sulfide has traditionally been used to dehair bovine hides; however, sulfide poses both a health hazard and an environmental hazard. Tanners have expressed an interest in eliminating sulfide from the tannery. ARS scientists at Wyndmoor, Pennsylvania, have developed a dehairing process based on alkaline sodium percarbonate (a white, crystalline, water-soluble chemical composed of sodium carbonate and hydrogen peroxide) that eliminates the use of sulfide from the tannery and eliminates sulfide from the waste stream. ARS is carrying out this research under a CRADA with a major domestic tannery and demonstrated that it is feasible to manufacture leather from oxidatively dehaired hides while concurrently reducing the amount of waste generated during the dehairing process.

Starch-based formulations with properties suitable for use in skin lotions. Jet-cooked lotion formulations for delivering pharmaceuticals and antimicrobials to the surface of human skin were previously prepared from mixtures of starch, lipid, pectin, and xanthan. These lotion formulations, however, exhibited an undesirable, sticky hand-feel when they were applied to the skin surface and allowed to dry. Researchers at Peoria, Illinois, have now shown that jet-cooked formulations, prepared from high-amylose starch and lipid in the presence of a fatty acid to complex the amylose component of starch, exhibit a smooth hand feel and do not pass through a sticky phase during drying. The Peoria scientists are working with CRADA partners to commercialize skin lotions prepared using this technology.

Genomics and sugar metabolism of probiotic human gut Bifidobacteria. Fundamental information is needed to understand how probiotic Bifidobacteria are beneficial to improved resistance to intestinal disorders. In collaboration with the University of California, Davis, researchers at Peoria, Illinois, sequenced the complete genome of Bifidobacterium infantis and demonstrated that this genome encodes all genes required to metabolize human milk oligosaccharides. This work has potential impact for research to design new prebiotics.

Commercial transfer of fruit and vegetable edible film technology. New processing technologies can provide new products that will increase utilization and consumption of fruits and vegetables by American consumers. Researchers in Albany, California, worked with an industrial CRADA partner to commercialize patent-pending, fruit- and vegetable-based films in a variety of final food product applications. One of these applications is the use of the films as healthy, colorful alternatives to the seaweed wrap 'nori' in a novel line of Sunny California rolls on sale at Trader Joe’s supermarkets around the country. Films were also sold commercially to a wide variety of up-scale restaurants, as well as for use as a healthy, flavorful glaze for hams and turkeys. The CRADA partner received a large loan from the San Joaquin Valley Revolving Loan Fund to build the film manufacturing plant in Stockton, California, an area of high unemployment. The ARS scientists helped the CRADA partner begin production in this new location in 2008, resulting in the hiring of four full-time professionals, two of whom are minorities.

Enhancing the Vitamin D content in mushrooms through novel UVB processing.

Approximately 60% of Americans are deficient in Vitamin D. ARS scientists in Albany, California, worked with a mushroom producer, through a CRADA, to implement and optimize processing conditions to naturally produce Vitamin D in mushrooms by brief exposure to UVB light. The process has been scaled up, and one serving of the mushrooms contributes 100% of the RDA of Vitamin D. Sensory results indicate that the acceptability of the treated mushrooms is equivalent to that of untreated mushrooms. The mushrooms are scheduled to be released in the marketplace nationwide in the near future. This research will help meet American nutritional needs while adding value to mushrooms.

Development of standard rice sample preparation procedures. There is a great need for developing appropriate standard rice sample milling and preparation procedures aimed at improving the consistency and accuracy of rice quality appraisal. Over the past 4 years, researchers at Albany, California, worked with collaborators at the University of California at Davis, USDA Grain Inspection, Packers and Stockyard Administration (GIPSA), and the California Rice Research Board in the systematic investigation of the rice sample milling mechanism and the effect of milling parameters on the appraisal of rice milling quality. Based on the scientific knowledge and results obtained by the researchers, a new rice sample milling standard was implemented in October 2007 by the USDA GIPSA. The adoption of the new rice sample milling procedure adds an estimated value of more than $20 million each year to the rice industry in the United States.

Collection of Russian dandelion germplasm. Russian dandelion, or Taraxacum kok-saghyz, produces high quantities of high-quality rubber in its roots. It has the potential to be a new rubber-producing crop in the United States, and there is a high level of industrial interest. ARS scientists from Albany, California, and Pullman, Washington, in collaboration with scientists from Kazakhstan, mounted a Russian dandelion collecting expedition in the high river valleys in southeastern Kazakhstan. Collections were made from 22 different populations and are being prepared for deposit in the USDA-ARS National Germplasm Collection. The deposition of Russian dandelion in the Collection will allow growth from only 2 viable accessions that are now available worldwide to more than 20 different accessions.

Quality and productivity of guayule latex. USDA CRADA research supports process optimization for and characterization of Yulex™, a guayule latex product, supplied by the Yulex Corporation, exclusive licensee of two USDA patents. Ongoing collaborative research and development through the CRADA evaluated physical and chemical properties of guayule latex over a more than one-year period. As reported by the USDA in 2007, guayule natural rubber latex met the ASTM Category 4 specification for all 11 ASTM physical and chemical methods throughout the testing period, and the data demonstrated that guayule latex has consistent physical and chemical properties, a requirement for successful commercialization. This work directly contributed to adoption of a new ASTM D1076-06 Category 4 standard for latex that is safe for people suffering from Type I latex allergy. In May 2008, the U.S. Food and Drug Administration announced 510(k) approval of the first product, an examination glove, made from guayule latex, a key milestone toward full commercialization. Research work on this CRADA project is funded by the Yulex Corporation.

Microbeads for protecting honeybees. The honeybee industry, which is critical to the success of agricultural production in crops that depend on pollination, has been under threat from colony collapse disorder, perhaps because of infestation of Varroa mites. ARS researchers in Albany, California, developed starch microbeads as slow-release agents to release miticides that control honeybee parasites. The microbeads contain heptanone and essential oils that control Varroa mites using technology for making starch-based microspheres in a controlled, critical size range, from 1 to 10 µm. The starch foam microspheres are used to control parasitic mites in honeybee colonies and may also have useful pharmaceutical applications.

Novel biobased plastic/fiber composites. Waste from unripened coconut is a large, under-utilized source of biomass that is the source of value-added fibers. ARS researchers in Albany, California, in collaboration with EMBRAPA scientists from Brazil, developed a biodegradable polymer/fiber composite material using waste from the unripened coconut. The addition of coconut fiber into starch-based plastics improved strength and flexibility. This technology has been introduced to potential commercial partners as an improved "green" composite/nanocomposite material that could increase the demand for coconut fiber and help local economies where coconuts are grown.

Development of high-performance mulches for the green industry utilizing cotton gin byproducts. The CRADA for this project was transferred from Summit Seed, Inc., in Manteno, Illinois, to Leggett & Platt, Inc., in Carthage, Missouri. Technology transfer continued with the new CRADA partner by developing goals and objectives to enhance the utilization of the technology. ARS scientists at Lubbock, Texas, provided guidance on equipment layout and processing necessary to implement the technology on a commercial scale. The guidance was provided on a soon-to-be-built facility that will use the technology to produce hydromulch. A hydromulch facility could result in a revenue stream of $20 to $30 per ton to cotton gins within the region of the plant. Value-added processing has resulted in a paradigm shift from thinking of gin byproducts as waste to considering the material as a revenue stream.