FY 2017 Annual Report for National Program 306
Product Quality and New Uses

Introduction

The USDA-ARS National Program for Product Quality and New Uses (NP306) in 2017 completed the third year of its 5-year research plans for the various research Projects. Scientists in NP306 continue to demonstrate impact in numerous and diverse areas of research that enhance marketability of agricultural products, increase the availability of healthful foods, develop value-added food/ nonfood products, and enable commercially-preferred technologies for post-harvest processing.

National Program 306: Quality and Utilization of Agricultural Products, Vision & Relevance can be found at: http://www.ars.usda.gov/research/programs/programs.htm?NP_CODE=306 and includes: the ***FY2015-FY2019Action Plan*** for NP306 which went into effect in summer 2015.

The overarching goal of NP 306 is to conduct research that develops knowledge and enables commercially-viable technologies to:
(1) Measure and maintain/enhance post-harvest product quality,
(2) Harvest and process agricultural materials, and
(3) Create new value-added products.

By developing commercially viable technologies that maintain/enhance postharvest product quality and create new products, ARS Quality and Utilization of Agricultural Products research increases the demand for agricultural products and, therefore, benefits both agricultural producers and rural communities.

During FY 2017, 184 full-time scientists and 25 vacancies working at 21 locations across the U.S. actively engaged in 68 ARS-base Projects and 81 ARS-led cooperative research projects in NP306.

Number of graduate students (16) and postdoctoral students (26).

The following scientists departed from the ranks of NP306:

Dr. Rick Byler, Stoneville, MS, retired	**Dr. Si-Yin Chung**, New Orleans, LA, retired	**Dr. Stephen Hughes**, Peoria, IL, resignation
Dr. Ed Hughs, Las Cruses, NM, retired	**Dr. Ryan Marsico**, Wyndmoor, PA, resignation	**Dr. Joseph Montalvo**, New Orleans, LA, retired
Dr. Rex E. Murray, Peoria, IL, retired	**Dr. James Rodgers**, New Orleans, LA retired	**Dr. Michael Tunick**, Wyndmoor, PA, retired

The following scientists were hired into the ranks of NP306:

Dr. Anthony Bucci, Wyndmoor, PA	**Dr. Juma Muturi**, Peoria, IL	**Dr. Majher Sarker**, Wyndmoor, PA

The following scientists in NP 306 received prominent awards in 2016:

Dr. Rick Byler, Stoneville, MS, received the Mayfield Cotton Engineering Award from the American Society of Agricultural and Biological Engineers.

Dr. Gima Biresaw, Peoria, IL received the Society of Tribologists and Lubrication Engineers (STLE), Nonferrous Council 2017 Leadership & Sustained Support Award.

Dr. Christopher Butts, Dawson, GA, elected Fellow of the American Society of Agricultural and Biological Engineers.

Dr. Mark Casada, Manhattan, KS, elected Fellow of the American Society of Agricultural and Biological Engineers.

Dr. Mark Casada, Manhattan, KS, received American Society of Agricultural and Biological Engineers 2016 Superior Paper Award.

Drs Brian Condon, Mike Easson, New Orleans, LA, SRRC Tech Transfer award.

Drs, Doug Hinchcliff, Brian Condon, Greg Thyssen, Chris Delhom, New Orleans, LA, Best paper - Journal of Experimental Botany.

Dr. Ching Hou, Peoria, IL, American Oil Chemists' Society, Ching Hou Biotechnology Award.

Dr. Soheila Maleki, New Orleans LA, SEA and the ARS Distinguished Senior Scientist of the Year Awards.

Dr. Jim Mattheis, Wenatchee, WA, elected Fellow of the American Society for Horticultural Science.

Dr. Tara McHugh, Albany, CA, elected Fellow of the Institute of Food Technologists.

Dr. Tara McHugh, Albany, CA, ARS Innovation Award – Office of Technology Transfer

Dr. Colleen McMahan, Albany, CA. Received the 2017 ARS-USDA Unsung Hero Award, presented by ARS Administrator, Dr. Chavonda Jacobs-Young.

Dr. Colleen McMahan, Albany, CA. Co-PI on a $5 million USDA-AFRI-CAP (a 2017 Regional Coordinated Agricultural Project) awarded to the University of Arizona's, Sustainable Bioeconomy for Arid Regions (SBAR) project, led by Kim Ogden under AFRI's Sustainable Bioenergy and Bioproducts Challenge Area.

Drs. Zhongli Pan and Tara McHugh, Albany, CA, FLC Far West Award for Outstanding Commercialization Success

Drs. Zhongli Pan and Tara McHugh, Albany, CA, ARS, PWA, Technology Transfer Award

Dr. Nasib Qureshi, Peoria, IL, elected Fellow of the Society of Industrial Microbiology and Biotechnology).

Dr. Diane Van Hekken, Wyndmoor, PA, elected Fellow of the American Dairy Science Association.

Dr. Dominic Wong, Albany, CA. Elected Fellow of the American Chemical Society, Division of Agricultural and Food Chemistry.

The quality and impact of NP 306 research was further evidenced in 2017 by the following:

- **325** refereed journal articles published
- **11** new patents
- **18** new patent applications, and
- **18** new invention disclosures submitted
- **8** current cooperative research and development agreements with stakeholders
- **29** new material transfer agreements with stakeholders.

In 2017, NP 306 scientists participated in research collaborations with scientists in 34 different countries: Australia (4), Austria (1), Bangladesh (1), Belgium (2), Brazil (9), Canada (5), Central African Rep. (1), Chile (1), China (22), Egypt (1), England (1), France (3), Ghana (1), India (3), Israel (3), Italy (3), Japan (3), Kazakhstan (1), Kenya (2), Mexico (2), New Zealand (1), Nigeria (1), Philippines (2), Portugal (1), Scotland (1), South Korea (10), Spain (2), Sweden (1), Switzerland (1), Tajikistan (2), Tanzania (1), Thailand (1), Turkey (3), United Kingdom (1).

NP 306 Accomplishments for FY2017

This section summarizes significant and high impact research results that address specific components of the FY 2015 – 2019 action plan for NP 306. Each section summarizes accomplishments of individual research projects in NP 306. Many of the programs summarized for FY 2017 include significant domestic and international collaborations with both industry and academia. These collaborations provide extraordinary opportunities to leverage funding and scientific expertise for USDA - ARS research by rapidly disseminating technology, which enhances the impact of ARS research programs.

This National Program is organized into three problem areas:

Foods

Problem areas of research are:
Define and measure quality
New bioactive ingredients and functional foods
New and Improved Food Processing Technologies

Non-Foods

Problem areas of research are:
Develop new post-harvest technologies
Enable technologies for (1) expanding market applications of existing biobased products, and (2) producing new marketable non-food biobased products derived from agricultural products and byproducts, and estimate the potential economic value of the new products.

Component 1: Foods

Crispy, healthy fruit and vegetable-snack drying system is commercialized. Currently the hot-air drying of fruit and vegetables is an important U.S. industry worth $50 billion annually, but is also the third largest industrial energy user in California. As a solution to substantially reduce energy usage and improve dried produce appearance and flavor, ARS scientists in Albany, California, developed a two-stage, infrared-blanching and hot-air drying system. Crispy, healthy fruit and vegetable snacks were produced at a commercial scale through the support of the California Energy Commission. The project demonstrated the novel drying system technology in producing healthy crispy snacks from carrots, kale, bell peppers, squashes, pears, and apples. This demonstration showed the benefits of the new technology, both in a 75 percent energy savings and a reduction in environmental pollution, while providing new healthy snacks with desirable texture and flavor at an affordable cost. This technology was recently licensed by a private company to produce healthy snacks, while saving energy and water.

A new walnut allergen (Jug n 4) officially identified. Tree nut allergies are equally as common and dangerous as peanut allergies, affecting millions of Americans and negatively affecting tree nut consumption. Thus an urgent need exists to define, measure, and mitigate the allergens from tree nuts and other foods. ARS scientists in Albany, California, and their collaborators have identified a new walnut allergen, which is now officially designated as Jug n 4 by the World Health Organization and International Union of Immunological Societies Allergen Nomenclature Subcommittee. The identification and characterization of this new allergen increases our broader understanding and occurrence of allergens in foods.

NIR based determination of astringency in persimmons. Different persimmon varieties have different properties in terms of astringency, with some always astringent, some never, and some rather unpredictable. When eaten, astringent foods can cause an unpleasant feeling in the mouth. ARS researchers in Albany, California, developed NIR calibrations that can classify persimmons according to their level of astringency. This allows producers to separate the unpredictable varieties before going to market. This provides the means to construct optical sorting devices based on reflection of light from a limited set of wavelengths that can sort persimmons at high speed.

Harvest date influences internal oxygen concentration in mandarins. Mandarins can develop poor flavor in storage that is disliked by consumers but the factors influencing this problem are poorly understood. ARS researchers in Parlier, California, harvested mandarins at various time points from early to late season and observed low internal oxygen concentrations and poor flavor in late season fruit. A potential cause for this was found to be lower peel oxygen permeability and a higher rate of respiration in late versus early season fruit. This finding helps enable a further understanding of how off-flavor occurs and enhances the ability to develop means to prevent it.

Soft-kernel durum wheat: a new bakery ingredient for baked goods and pasta. The cultivation of durum wheat has been known for centuries for its greater yields than other wheat varieties, especially soft wheats, even under drought environments. But durum wheat use is restricted mostly to making semolina pastas because of its very hard kernel texture. ARS scientist in Pullman, Washington, in cooperation with colleagues at Washington State University, determined that the milling and baking qualities of the newly bred soft-kernel-texture durum wheat to be similar to those of soft white wheat, thereby allowing it to be used in making muffins, pancakes, quick breads, biscuits, and pie crusts. This technical advance in being able to soften durum wheat and demonstrating its end-use applications and performance is critical in assisting millers and bakers in using this new soft wheat.

'Honeycrisp' apple bitter pit is reduced by 1-methylcyclopropene or short-term controlled atmosphere (CA) storage. The apple physiological disorder bitter pit is an unsightly peel cosmetic defect that results from several factors existing in orchards prior to harvest. Bitter pit symptoms often do not arise until fruit have been harvested and placed into cold storage. ARS scientists in Wenatchee, Washington, collaborating with scientists at Washington State University, showed bitter pit incidence is reduced by storing apples in a controlled atmosphere with low oxygen and high carbon dioxide content relative to air for as little as 1 week after harvest. The efficacy for bitter pit reduction of a week of CA immediately after harvest may allow producers to reduce disorder potential while allowing fruit to be marketed early in the harvest season.

Detection of internally insect infested popcorn. Rapid detection of insect pests that develop inside grain is a challenge for the grain, milling, and food processing industries, since there is little external sign of infestation. We developed a conductive roller mill to detect insect infested seeds by grinding the grain using a pair of grinding rolls with a low voltage connection across them to detect changes in circuit resistance when insect infested seeds are ground. The mill was able to detect 80-90 percent of the medium and large insects. The conductive roller mill provided rapid processing and reasonably high detection effectiveness and could be used as a useful tool for industry stakeholders in their evaluation of grain during inbound inspection and during storage.

Confirmation of gluten-free status of wheatgrass. Wheat grass is consumed as a juice of freshly harvested leaves or reconstituted from powdered leaves to alleviate symptoms of ulcerative colitis and severe anemia resulting from chemotherapy. As a wheat product, persons on a gluten-free diet were concerned as to the gluten status of wheat grass. ARS researchers at Manhattan, Kansas, tested a commercial product and freshly grown wheat grass using the gluten specific enzyme-linked immunosorbant assays (ELISA). Data confirmed wheat leaves contain no gluten proteins as measured by specific antibody binding. Therefore, wheat grass contains no detectable gluten and may be safe for consumption by patients suffering from celiac disease or other gluten related disorders.

Potato cultivars with reduced acrylamide concentration identified. Acrylamide is an unwanted and potentially toxic by-product produced when carbohydrate-rich foods are processed at high temperatures. In participation of the National Fry Processing Trial, sponsored by Potatoes USA (formerly U.S. Potato Board), and in cooperation with publically funded plant breeders and the potato industry, the postharvest storage and processing qualities of 48 advanced clones grown in Washington, Idaho, North Dakota, Wisconsin, and Maine have been evaluated for process quality and acrylamide levels using standardized storage, processing, and evaluation procedures developed by the East Grand Forks Potato Research Worksite. Several clones exhibiting excellent processing characteristics and very low acrylamide levels have been identified. These clones will be evaluated in more detailed trials and may be candidates to replace currently used varieties in the commercial production of processed potato products. Eventual adoption of these clones and consequent reduction in the acrylamide concentration of potato products will benefit both producers and consumers.

Development of new resins/adhesives from dried distiller's grains and solids. An inexpensive, non-toxic adhesive/resin was developed by ARS researchers in Peoria, Illinois, to substitute for petroleum adhesives/resins. This novel adhesive/resin was produced out of by-products from wet milling ethanol production. These wood composite panels were found to be comparable or superior to mechanical properties required by industry standards, offering a multitude of applications in the building, furniture, and manufacturing industries. Dried distiller's grains and solids (DDGS) adhesive was found to be superior to adhesives prepared from soybean flour, which is the industry's standard. The sources for the starting materials are only a fraction of the costs of petroleum-based or soybean-based adhesives/resins.

Plant-based gums expand navy bean starch uses. Pulses are typically consumed as whole beans or flours, but there is also growing interest in the use of pulse protein concentrates and isolates, which leads to a coproduct of pulse starch that can be utilized. Starches are often unsuitable to be used directly in food applications, but gums can improve starch properties without chemical modification. ARS researchers in Peoria, Illinois, investigated the effects of gums on pasting, water absorption, freeze-thaw stability and textural properties of navy bean starch gels. Improving navy bean starch and flour properties through the addition of gums, can guide their use in food products. Utilization of the starch coproduct will enhance the profitability of isolating protein from pulses to meet the increasing demand for protein supplements in foods and beverages.

Amaranth-oat composites replacements for wheat flour. Replacement of wheat flour was developed using gluten free amaranth flour containing essential amino acids and minerals with oat products containing beta-glucan, known for lowering blood cholesterol. Amaranth flour and oat bran concentrate (OBC) composites (1:4) were processed using different technologies, including dry mixing, baking, steaming, cold wet blending, homogenization with cold water, and homogenization with hot water. ARS researchers in Peoria, Illinois, showed results that water holding capacities, pasting, and rheological properties, which are important parameters for processing in an industrial setting and handling, and consumers' sensory responses, were

dramatically increased by wet blended, homogenization with cold water, and homogenization with hot water followed by drum drying. The processing procedures created dissimilar physical properties that will enhance the application of ancient grains and oat for functional foods that are suitable for people who are gluten-intolerant. This line of composites can be used to replace wheat flour in many baking foods, potentially creating a new market for gluten-free and health food markets.

Solving the mystery behind making perfect steamed bread. Steamed bread, typically made from soft wheat flour, prepared by steaming instead of baking, is produced and consumed throughout the world, and is creating a greater demand for high-quality, U.S. grown, soft wheat. Soft wheat flour protein concentration and quality together are known to be major factors in making steamed bread, but their independent roles were unknown. ARS scientists in Wooster, Ohio, determined the role of protein quality in making steamed bread, and found that soft wheat flour that contains a strong gluten protein produced steamed bread with a smoother surface, higher volume, better crumb structure and texture, and higher total quality score than wheat flour with relatively weak gluten protein. This information has been provided to wheat breeders, because protein quality is controlled by breeding. It will serve as a screening guide in developing wheat varieties with strong gluten protein for use by food manufacturers who wish to make consistently high-quality steamed bread products.

Rapid imaging method for detecting a poultry meat quality defect. The woody breast condition is an emerging quality defect in chicken breast meat that is currently assessed through product handling and a subjective classification system. The current system of evaluation does not allow for adequate detection and product segregation at commercial poultry processing line speeds. ARS researchers in Athens, Georgia, have developed a rapid, non-destructive imaging technology to objectively detect the presence and severity of the woody breast condition in chicken breast fillets. They have developed a prototype system that demonstrates the feasibility for online detection of this quality defect at commercial processing line speeds. This system will provide processors a tool that can be used in a commercial setting to rapidly inspect breast fillets and facilitate product segregation, which will lead to fewer customer complaints and improved product uniformity.

Development of a rapid method for purification and detection of hazelnut, peanut, and walnut allergens. The food industry, regulatory agencies and other research partners are in search of rapid, large-scale production and detection of allergens. ARS scientist's research in New Orleans, Louisiana, provided tools for regulators and the food industry to detect and confirm the presence and the state of peanut and tree nut allergens in processed foods or on surfaces.

A new technology enables on-demand fruit ripening and reduces waste. The United States is losing up to 40 percent of its food at a cost of $165 billion annually. The main contributors are product spoilage due to varied fruit ripening times, spoilage during shipping, and rapid quality loss when ethylene, a plant hormone, is applied to promote ripening. Ethylene is a highly flammable gas and is only applied by skilled operators using specialized produce shipping or

storage containers. In these conventional ethylene applications, large containers of fruits ripen at once and spoilage occurs before it gets to the consumers. To solve this problem, ARS scientists in Beltsville, Maryland, developed a new method to embed the ethylene gas in a plastic coated with copper. This process is being patented. Now ethylene can be applied by anyone when needed, shortening the time between when fruits ripen and when they are consumed. This new technology reduces product waste while maintaining excellent quality, longer shelf life, and better nutrition.

Component 2: Non-foods

Guayule-rubber tires: establishing a U.S. rubber-production industry. *Parthenium argentatumm,* commonly known as guayule (gwai'u'li), is a flowering shrub native to the southwestern United States. The plant has been studied for nearly 150 years as a possible source of natural rubber, organic resins, and as a biofuel feedstock. In the 1920's guayule became a likely important source of rubber after leaf blight destroyed the Brazilian rubber industry. However, no additional effort to make rubber from guayule was attempted until World War 2, when America's total source of rubber was under a blockade after Japan cut off the U.S. sources in Malaysia. Currently, the United States tire industry still relies on 100 percent imported natural rubber, which comprises 80 percent of a tire. Developing guayule-rubber for use in modern tires is critical for supplementing the ever-growing need for rubber worldwide, and in particular, for developing a U.S. natural rubber-production industry. With funding from the USDA National Institute for Food and Agriculture (NIFA), the USDA Agricultural Research Service (ARS) led a 5-year collaborative research effort to domesticate and develop a commercial guayule farming system in Maricopa, Arizona, for rubber production, and to refine rubber biotechnology and chemistry for converting the plant into rubber at commercial scale in Albany, California. In collaboration with university partners and rubber and tire industry leaders, ARS produced breakthroughs in guayule rubber processing, stabilization, and performance that allowed passenger tires to be produced with 100 percent guayule rubber. The tires, developed by an industry partner, passed both the specified testing by the U.S. Department of Transportation and the more stringent internal industry testing. Seventy-five percent guayule-rubber tires with exceptional wear and performance are available commercially at a price comparable to high performance tires.

Environmentally-friendly BBQ "starter" charcoal. Millions of consumers use lighter fluid to light charcoal for cooking, thereby contributing to the level of volatile organic compounds in the air around residential neighborhoods. ARS scientists in Albany, California, developed a porous charcoal material from plant waste using plant starch to bind biochar powder from walnut and almond hulls into quick igniting charcoal briquettes that can be easily lit without lighter fluid. The "starter" briquettes can be used to ignite traditional briquettes without the use of lighter fluid. This patented technology will help consumers comply with regional air districts' recommendations to reduce air polluting activities when air alerts are issued.

Replacing petroleum-derived packaging foams with sustainable wheat-based foam. Most foams used in packaging and manufacturing applications are produced from petroleum-derived sources and are not biodegradable. They accumulate in landfills and can be hazardous to marine life. ARS researchers at Albany, California, have developed a high-temperature process to quickly produce biodegradable wheat gluten-based foams that have properties that are comparable to those of petroleum-derived foams. Some additional plant-based additives such as fibers, minerals, and other biodegradable additives were incorporated into the foams to vary their properties for various industrial uses. These wheat-based foams may serve as an environmentally friendly alternative to petroleum-derived foams in packaging, manufacturing, and building applications.

Onboard cotton harvester monitor for weighing and calibrating yield. A novel system for measuring cotton weight onboard commercial cotton harvesters was developed and successfully tested by researchers in Lubbock, Texas. The system uses hydraulic pressure measured in the harvester basket lift cylinder circuit along with a specially developed algorithm to calculate the weight of cotton in the harvester basket. Plot average seed cotton yield is calculated from the hydraulic weight measurement and area harvested measured by an integral GPS system. The system provides essential weight data for producers or researchers seeking to calibrate cotton yield monitors, and it can be used as a stand-alone tool to conduct on-farm research in which total plot seed cotton yield is the evaluation metric. This system costs about $5,000 to build and install, saving producers or researchers on the order of $45,000 for a mobile scale system typically used to provide seed cotton weight measurements. Through the development of this system, producers now have access to low-cost, reliable cotton weight data on a real-time basis which will help them adopt site specific management practices which can save thousands of dollars each year in reduced input costs.

Discovery of microbe capable of killing mosquito eggs. ARS scientists at Peoria, Illinois, discovered a microbial isolate that possesses characteristics that make it a suitable biocontrol agent for mosquitoes. The microbe can grow at a wide range of temperatures and can successfully infect mosquito eggs even at low temperatures and did not grow at temperatures above 32°C. These findings suggest that this microbial strain is a promising candidate to further advance as a biocontrol agent of mosquitoes. Once developed, this microbe could be used in concert with other methods to minimize the use of harmful synthetic pesticides.

Improved water resistant paper and cotton materials. There are numerous routes to produce water resistant paper or cotton fabrics, however, these approaches typically use petroleum-based hazardous chemicals. ARS scientists in Peoria, Illinois, have found that cellulosic articles, such as paper or cotton fabrics, can have dramatically increased water resistance by applying certain starch complexes to them. The degree of improvement is such that an applied water droplet may evaporate before soaking into the article. An US patent application has been filed covering this technology. This technology will be able to replace techniques which utilize hazardous chemicals and processes allowing for water resistant paper and cotton articles which will be less expensive and have a smaller carbon footprint. These new products will result in

new applications for corn starch and allow new markets for paper and cotton articles, benefiting producers and processors.

A new sugar for food and biomedical applications. As part of an ongoing investigation aimed at using bacteria and enzymes to create new high-value products from cane or beet sugar, ARS researchers in Peoria, Illinois, have engineered bacterial enzymes that are capable of producing high yields of a novel type of sugar for use in the pharmaceutical, agricultural, and food industries. This sugar, named isomelezitose, was previously found in trace amounts in honey, but efforts at commercialization were hampered by production costs. This new enzyme can produce isomelezitose in yields around 50 percent of the theoretical maximum, a major improvement over previous methods. A patent application has been filed on this invention, and researchers are currently demonstrating potential applications of the novel sugar. These include prebiotic food ingredients for improved intestinal health, and cryopreservatives for improving the long-term storage stability of foods, drugs, vaccines, and agricultural bio-control agents.

Lubricant additives from a modified dietary supplement. Establishing and growing a billion ton bioeconomy as a component of the U.S. economy requires the development of processes to convert sustainable agricultural commodities and materials to novel, higher value, non-food products with useful properties. ARS scientists in Peoria, Illinois, have developed a process using a solid acid catalyst to convert lipoic acid, a sulfur-containing, fatty acid dietary supplement, and various alcohols into vegetable oil soluble materials with good lubricant additive properties. Collaborators demonstrated the improved performance (e.g., peak oxidative temperature, four-ball extreme pressure, viscosity index) of both vegetable oil-based and synthetic lubricants when formulated with the lipoate materials. This technology expands the application of the existing dietary supplement, lipoic acid, from the health and personal care markets to new industrial markets.

Corrosion inhibition using a natural coating. A corrosion inhibitor is a coating material that prevents or decreases corrosion rates when applied to a metal or alloy. Corrosion causes severe economic losses to machinery and infrastructure, and represents a safety hazard as it results in loss of strength and structural integrity. The global market of anti-corrosion coatings is projected to reach $20 billion by 2020. ARS scientists in Peoria, Illinois, have developed patented technology that uses a water-dispersible, natural polymer harvested from bacteria as a corrosion inhibitor. This patented technology is used at very low concentrations reducing Volatile Organic Compounds (VOCs) and can be applied by existing spray technology similar to paints. The anticorrosive coatings are very thin (nano-scale), bond tightly to the metal surfaces and can be painted as a final finishing step, providing a new product to the multimillion dollar anticorrosion industry.

Encapsulation of natural pesticides. Biopesticides provide an alternative to the use of chemical insecticides; however, biopesticide efficacy is affected by climatic conditions, especially rain that washes away the products. ARS in Peoria, Illinois, have encapsulated spinosad (as a model

pesticide) in tiny particles that adsorb on the surface of leaves, reducing wash-off by rain or morning dew and increasing exposure to insects, thus reducing application of pesticides as well as environmental contamination. This encapsulation technique can be extended to other pesticides and possibly herbicides and fungicides.

The silver nanoparticle-cotton system, showed stable and durable antimicrobial properties in laundering tests. Simply copying the nanotechnology developed in other fields, i.e., buying nanoparticles, nanotubes, or nanocrystals and applying them onto textiles, have raised environmental, health, and performance durability issues. A great deal of originality is required to develop safe and durable nanoengineered cotton. The uniform dispersion of silver nanoparticles inside the fiber was not influenced by fifty cycles of laundering, and the laundered nanocomposite fibers retained 92 percent of the silver nanoparticles in concentration. More importantly, powerful antibacterial activity against Escherichia coli and Staphylococcus aureus maintained after laundering. This nanocomposite fiber will continuously deliver antibacterial activity wash after wash, making it potential for antibacterial washable wipes.

High-speed roller ginning of upland cotton results in superior quality yarn production. Most upland cotton is ginned using saw gins. Although saw gins cause more fiber damage, they are much faster than roller gins. High-speed roller gins were designed by ARS scientists in Mesilla Park, New Mexico, to address the speed limitations. This technology was adopted by extra-long staple cotton producers, but not the far more common upland cotton producers and ginners. ARS researchers in New Orleans, Louisiana, demonstrated that the increase in fiber length and length uniformity afforded by high-speed roller ginning allowed finer yarns to be produced at a higher processing rate than could be produced by saw ginning. The higher processing rates help offset the increased cost of high-speed roller ginning. The ability to produce finer yarns opens up additional export markets where the demand for longer fiber length and improved uniformity has pushed customers towards foreign cotton sources.

Natural oral care with antimicrobial activity. Surfactants are compounds that contain oil- and water-loving parts/components, and are used in the formulation of oral care products such as tooth paste and mouth wash. Commonly used surfactants are made either with petrochemicals or through harsh processes, and they lack bacterial inhibitor and often must be supplemented with antimicrobial agents such as triclosan. ARS researchers at Wyndmoor, Pennsylvania, in collaboration with an industrial partner had successfully tested and showed the antimicrobial activity of several forms of sophorolipids (a natural glycolipid surfactant produced by benign yeasts) against tooth-decay causing bacteria called streptococci and lactobacilli. The outcome is expected to heighten commercial interests to use sophorolipids in the formulation of oral care products with value-added antimicrobial property.

Hide decontamination treatment to improve beef safety and preserve hide quality. Bacterial cross-contamination from the haired outer surface of the hide to the meat during slaughter is recognized as a hygienic problem for commercial beef facilities. Treatments known to

decontaminate the hide may erode the hide surface, decreasing its value to the leather industry. ARS researchers at Wyndmoor, Pennsylvania, collaborating with Safe Foods, Inc., investigated the efficacy of a spray treatment with two antimicrobials on three regions (head, belly, and butt) of the haired cattle hide. Both antimicrobial independently, effectively reduced bacterial concentrations on freshly procured cattle hides. Physical and mechanical tests revealed no damaging effects on crust leather produced from the treated hides with either formulation. The results from this study demonstrated that antimicrobial spray washing with the two antimicrobial solutions can effectively reduce harmful bacteria on cattle hides to the benefit of the beef and leather industries.