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Action Plan: National Program 306
Quality and Utilization of Agricultural Products

Goal: ARS National Program 306 (NP 306), Quality and Utilization of Agricultural Products, will enhance the economic viability and competitiveness of U.S. agriculture by maintaining the quality of harvested agricultural commodities or otherwise enhancing their marketability, meeting consumer needs, developing environmentally friendly and efficient processing concepts, and expanding domestic and global market opportunities through the development of value-added food and nonfood technologies and products, except energy and fuels.

In June 2008, NP 306 leaders and scientists met with stakeholders from industry, universities, and other government agencies to assess the past performance of this national program and to develop a list of needs that will help guide the direction and focus of the program during the next 5-year management cycle. Many of the research needs identified by stakeholders over the past several years continue to be relevant today and are addressed in the current action plan. However, new research needs were also identified in response to issues and concerns of our changing society, economy, and environment.

NP 306 addresses postharvest quality and processing of foods and fibers, including development of value-added non-food biobased products, and foods that are safe, high quality, and which promote human health. Consumers demand food products that are safe and produced using processes that are *friendly* to people, animals, and the environment. NP 306 research will increase our knowledge and develop technologies to better measure or enhance the quality of crop and animal products after harvest. Similarly, the marketability and value of commodities can be increased by ensuring that value-added food products (such as fresh-cut or minimally processed produce) retain sensory quality, nutritional value, and are free from food safety hazards. The research in this National Program will also generate new information on health promoting components of foods and assess their effects on important human diseases and obesity, in cooperation with the Human Nutrition National Program (NP 107) and other partners.

In addition to food quality and safety, consumers have expressed concern over rising food prices, which can be attributed to multiple factors including high petroleum prices and decreasing food supplies due to high export demand and crop failures. A significant factor in the cost of food production can be attributed to food waste or rot. Estimates indicate that approximately 27% of food produced in the U.S. is lost as waste among retailers, food service businesses, and consumers. Additional losses occur during food harvesting, storage, and distribution. The magnitude of the loss is even greater when resources spent on growing food such as fuel, water, fertilizer, chemicals, land-use and human resources are considered. NP 306 research will develop technologies that improve quality, extend product shelf life, reduce waste and decrease costs.

NP 306 supports research on the development of nonfood, nonfuel biobased products from agricultural commodities and byproducts. Interest in biobased products has increased as consumers and governments have sought more environmentally friendly products that provide alternatives to petroleum and which do not contribute to greenhouse gases. Thus, biobased products can reduce our dependency on petroleum and provide a more sustainable technology for the future. Biobased products that were once too expensive to commercialize may now be affordable. There is some public concern that biobased products could contribute to the rising cost of food in the U.S. Thus, NP 306 research will seek opportunities to develop biobased products from agricultural feedstocks that do not compete with food, in cooperation with other ARS national programs and partners.

NP 306 also supports research on crop fiber and animal hides, leather and wool quality and processing. Stakeholders who produce fibers and hides constitute an important segment of our rural economy. These industries are severely impacted by energy and production costs and have lost market share to foreign competition. Technologies that improve fiber quality, reduce the energy consumption of processing equipment, and develop new products are needed to help the fiber industry to compete in a global market.

Relationship of This National Program to the ARS Strategic Plan: Outputs of NP 306 research support the "Actionable Strategies" associated with the performance measures shown below from the *ARS Strategic Plan for 2006-2011*, Objective 2.1: *Expand Domestic Market Opportunities*.

> **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. **Target:** 2011 – Cumulatively, 20 new technologies developed by ARS and adopted for uses that provide food crops and products with higher quality and extended shelf life; convenient and acceptable healthy foods' non-food, non-fuel biobased products with cost and performance features comparable or superior to petroleum-based products; and valuable co-products from agricultural residues and processing wastes.

Component 1. Foods

Problem Statement 1.A: Define and Measure Quality

The quality of a food derives from measurable chemical, nutritional, physical, and sensory properties and their complex interactions. Quality is the composite of those attributes of the food and its latent ability to be efficiently milled, malted, baked, cooked or otherwise processed into appealing, flavorful foods and beverages. Inaccurate or uninformative quality assessment methodologies are detrimental to producers, processors, and ultimately consumers of food products. Quality is assessed and measured at many points from the farm through processing to final packaging and marketing. Quality assessment often requires destructive sampling, expensive equipment, technically advanced protocols and skilled labor, all of which increase final cost to the consumer. NP 306 technologies link crop and animal improvement programs with the food processing industry and consumers. Therefore, ARS research will develop, evaluate, and

implement methods to accurately assess food quality for research, production and manufacturing programs, leading to improved food quality from farm to consumer.

Research Needs

Knowledge is lacking about how the underlying chemical and physical properties and processing affect final product quality and sensory characteristics. This requires a better understanding of how genetics, production practices, pre- and postharvest environmental conditions, and mechanical handling influence quality. New crop cultivars and animal breeds carry with them the potential for altered food quality, and these changes need to be quantified and described. Measurable chemical, nutritional and physical properties must be related to sensory perception. New sensors are required to accurately measure chemical, nutritional, physical, and human sensory properties of agricultural commodities throughout the supply chain. New and improved methods to monitor product quality during postharvest handling and storage are necessary. These technologies will be optimized for accuracy, throughput, and, when necessary, their ability to be nondestructive. Methods are needed to detect and remove contaminants, defects, and other grade-reducing factors.

Anticipated Products

- Product quality descriptions and assessments based on measurable chemical, nutritional, physical, and sensory attributes.
- New laboratory and pilot scale food processing methods to better replicate commercial processes and improve bench-top evaluation of cultivars, harvest methods, storage and processing procedures.
- Baseline food composition information on effects of storage and postharvest processing.
- Identification of plant and animal genes that affect the quality of food (through cooperation with NP 301).
- Sampling strategies to accurately measure quality attributes and detect defects.
- Efficient, high-throughput and non-destructive technology to grade, sort, and assign value to food based on desired quality traits after harvest.
- Sensor technology to assess product quality and maturity in the field for optimum harvest timing.
- Technology to detect and remove contaminants or defective product from the food chain.

Potential Benefits (Outcomes)

- Innovative research linking physical and chemical attributes, genetics, and harvest maturity to sensory and performance traits will produce rapid, inexpensive, product quality assessment.
- Faster delivery of improved crop cultivars through development and implementation of improved definitions of quality and methods to accurately assess cultivar quality.
- Improved measurement of quality will allow producers and processors to reduce costs and improve product consistency through segregation of raw materials according to desired quality characteristics.

- Food processing and production management decisions based on improved quality assessments will result in improved yield and product quality while minimizing product loss from spoilage, infestation, contamination, and poor quality.
- Sensors, quality definitions, and accurate measurements of quality attributes will provide the means to measure the effects of various additives/supplements. The improved measurements (instruments and methods) should measure differences in product quality and relate them to consumer perceptions and expectations.
- Technology to detect and remove contaminants or defective products from food streams will minimize product loss and provide higher quality food to consumers.

Problem Statement 1.B: Preserve or Enhance Quality and Marketability

Consumers intuitively seek food that is at optimal quality and value. They bring to the marketplace quality preferences that influence their choices. Quality that appeals to consumers and is useful for food processors is often transient. As a result of internal biochemical processes and external factors (e.g., insect and microbial activity, storage conditions, processing practices), desirable quality attributes often change with time after harvest. Uncontrolled sprouting, product moisture content, temperature, relative humidity, concentrations of atmospheric gases, and harvest and handling damage are known to affect the rate of deterioration. In contrast, aging and fermentation of some foods can enhance product quality while extending shelf-life. New information and methods are needed to preserve and enhance the quality and utilization of agricultural products. Processes and compounds that accelerate or inhibit degradation will be identified. Novel methods of treating, storing and processing agricultural commodities and foods will be developed that optimize product quality delivered to the consumer.

Research Needs

Postharvest biochemical processes need to be correlated to their effects on quality throughout storage and processing. Knowledge of internal processes is needed to improve existing management practices and develop innovative techniques to enhance or minimize loss of product quality. Instrumentation systems are needed to monitor product quality in storage and modify the storage conditions to minimize deterioration. Systems are needed for "identity preservation" from the farm to the retail market.

Anticipated Products

- Descriptions of biochemical processes and metabolites that cause quality deterioration during storage.
- Tools to effectively manage postharvest processing and storage systems, including instrumentation, control systems, and decision support systems.
- Innovative storage systems and treatments that maintain product quality and integrity and protect products from pathogens and insects.
- Technology for improvement of packaging, storage containers, and food coatings through humidity and temperature control, and atmosphere regulation. This will extend the shelf-life of food and preserve flavor.
- New methodologies to enhance the quality and utilization of agricultural products.

Potential Benefits (Outcomes)

- Reduction of loss caused by inadequate post-harvest storage.
- Innovative storage systems will be developed to maintain product quality and identity.
- Low cost storage systems that can be used for temporary short-term storage at harvest and for emergency food shortages during domestic and international crises.
- Improved utilization of products through quality enhancement techniques.
- Globally competitive, high quality products with extended shelf life.

Problem Statement 1.C: New Bioactive Ingredients and Functional Foods

Foods not only provide essential nutrients for sustaining life but also can impart healthy physiological responses that prevent or delay chronic diseases, such as obesity, diabetes, and colon cancer. Functional foods contain bioactive food ingredients, or nutraceuticals, that promote health beyond basic nutritional value (calories, basic metabolic requirements). Functional foods can be from plant, animal or microbial sources and bioactive ingredients include naturally occurring or induced phytonutrients from plants, probiotic bacteria and prebiotic oligosaccharides. The public health promise of the nascent functional foods industry necessitates a multi-pronged research approach to identifying biologically active compounds in agricultural materials and functional foods, characterizing their structures and physiological functions, and examining the interplay between biologically active constituents and nutritional components in functional foods. Identification of these constituents, in turn, facilitates agronomic practices and breeding of crop cultivars, livestock or microbial strains with enhanced bioactive qualities.

Research Needs

New discoveries are needed to reach the full potential of bioactive ingredients in foods. These should include the roles of bioactive ingredients in health promotion benefits and prevention of chronic disease, and the effects of environment and processing on health-promoting potentials of functional foods. Broad development of functional foods also will require the availability of bioactive compounds in foods and various food delivery systems with improved understanding of the role of the environment in preserving the activity of bioactive ingredients under extended shelf-life conditions. Common structural motifs responsible for activity are present in many bioactive ingredients; yet these motifs are poorly characterized and understood. Synergistic and antagonistic relationships between bioactive food ingredients and nutritional components in food matrices exist but are insufficiently characterized at this time. New sources for functional food ingredients as well as new bioactive ingredients should be identified, isolated and characterized using innovative instrumental and bioassay techniques. Expansion of knowledge is needed for probiotic bacteria and their role in promoting health as well as prebiotic oligosaccharides that stimulate the growth of probiotic bacteria. New information on bioactive ingredients should be related to metabolic pathways, regulatory genes, population subgroups and the development of probes (simple colorimetric assays, high-throughput analytical techniques, gene specific molecular markers, etc.) for

rapid evaluation of new sources of high-valued compounds to aid in predicting which population subgroups will respond positively to the bioactive compounds.

Anticipated Products

- Functional foods with enhanced levels and activities of bioactive ingredients with established efficacy, bioavailability, and safety that represent cost-effective dietary interventions for chronic disease prevention.
- Identification of new bioactive ingredients (i.e., antioxidants, polyphenolics, fibers, phytosterols, peptides, probiotic bacteria, prebiotic oligosaccharides) and methods to standardize their minimum concentration in foods for health and labeling claims.
- Proteomic, metabolomic and nutrigenomic tools for evaluation and characterization of bioactive ingredients.
- Improved biomarkers to predict success of full-scale human clinical trials and alleviate the need for animal testing (in cooperation with the Human Nutrition national program and other partners).
- Innovative and improved delivery systems for functional food bioactive ingredients (i.e., novel encapsulation, nanoemulsion, controlled release, protein-based "natural", probiotic bacteria, synbiotics).
- New and improved crop varieties, livestock, and microbial strains as sources of bioactive ingredients (in cooperation with other ARS national programs and other partners).
- Development of new health-promoting foods for the elderly and populations most prone to chronic diseases.

Potential Benefits (Outcomes)

- New food products that potentially stave off health problems caused by aging, and infectious or chronic diseases, thus reducing health care costs in the U.S.
- Enhanced competitiveness of the U.S. food industry in the global marketplace.
- Increased values of crops, livestock or microbial strains used as functional foods or raw materials for functional foods as a benefit to the U.S. rural economy.
- Improved understanding of mechanisms of action of bioactive food ingredients and their role in human health and prevention of diseases.

Problem Statement 1.D: New and Improved Food Processing Technologies

Food processing should make safe, nutritious, and convenient food readily available throughout the year and in every American community. Challenges to assure our food supply in the 21st century have grown complex through a matrix of rising energy costs, environmental imperatives, the capacity for unsafe food to be rapidly and widely distributed, and increasing world demand for high quality foods. Major opportunities exist along with these challenges. Recovery of valuable bioactive food ingredients from processing operations can increase the economic value of foods, while reducing environmental impact. New concepts for preservation, increased understanding of sensory mechanisms, and new structure-function relationship insights for food ingredients may make it possible to create new nutritious foods with excellent sensory properties. The U.S. needs expanded food processing research both to realize the

opportunities and to successfully meet the challenges required to assure an affordable, high quality food supply.

Research needs

Improved non-thermal preservation techniques will ensure product stability and safety. These preservation methods should enhance retention and bioavailability of nutrients and beneficial bioactive food ingredients while retaining desirable sensory characteristics. New processes and technologies are needed for protecting, stabilizing, or maintaining the activity of sensitive food components (vitamins, probiotics, bioactive peptides, fatty acids), throughout processing, storage, and component delivery. Large-scale processes with minimal environmental impact are needed to replace aging technologies associated with high energy demand, high water usage and/or high wastewater load. Also, processes are required to convert food byproducts (hulls, fruit peels, pulp, pomace, oil seed meal) to commercial products through capture of fiber and bioactive ingredients. New food processing technology should be developed to create food structures and matrices at the molecular level with specified function that can boost the quality and nutrition of processed and snack foods for health and wellness. Economical small scale technologies are needed for value-added processing of locally produced commodities on or near the farm, for local direct marketing of high quality products. Continued improvement is needed in techniques to control the growth of spoilage microorganisms and human pathogens. Processes are needed that can convert off-size and off-appearance raw products or by-products into highly functional, high nutrition food ingredients or non-food products. New packaging and coating technologies are needed to protect or enhance the properties of foods and to extend their use to shelf-stable packaging systems.

Anticipated Products

- More efficient food processing techniques that reduce energy use, water use, and waste generation per unit of food delivered to consumers.
- New processes (separation, concentration, extraction, fractionation) to convert low value commodities or by-products into higher value food ingredients or non-food products.
- Food technologies yielding foods with enhanced nutritional benefits including low and nonfat foods/low sodium foods.
- Increased methods to safely and economically produce and distribute locally produced foods.
- Foods tailored to meet nutritional requirements for the School Lunch Program, Food for Peace and similar programs (in cooperation with the Human Nutrition national program and other partners).
- Protein-based food ingredients, ranging from native to modified proteins, for fortification of foods and beverages.
- New protective films and coatings for foods made from proteins, carbohydrates, lipids and other food components to enhance appearance, improve quality, and contribute to the function of shelf-based packaging systems.
- New technologies for production of shelf-stable and extended shelf-life food products containing bioactive ingredients.

- Best practices for government and industry responders for destruction of contaminated foods and restoration of factory and farm premises (in cooperation with the Food Safety national program and other partners).

Potential Benefits (Outcomes)

- Continued availability of adequate, healthy, and affordable food supply for the U.S. population.
- Improved ability to optimize the nutritional, functional, textural, and sensory properties of foods.
- Increased ability for farmers and processors to deliver foods that have proven health benefits to people.
- Improved safety in the U.S. food supply.
- Reduction of the environmental impact (e.g. petroleum-based energy use, water use, air pollution, greenhouse gas emissions) required to safely produce and deliver food to consumers.
- Assistance for U.S. food processors to remain economically competitive in the global market place.

Component 1 Resources

The following ARS locations have research projects addressing the problem statements identified under Component 1:

Albany, CA; Athens, GA; Beltsville, MD; Dawson, GA; East Lansing, MI; Fargo, ND; Lane, OK; Madison, WI; Manhattan, KS; New Orleans, LA; Oxford, MS; Parlier, CA; Peoria, IL; Pullman, WA; Raleigh, NC; Wenatchee, WA; Weslaco, TX; Winter Haven, FL; Wooster, OH; and Wyndmoor, PA.

Component 2. Fibers

Globalization of production and markets for raw cotton and wool, yarn and their derived and finished products, raw animal hides, and finished leather products has resulted in new challenges to the U.S. fiber and hide industries. These challenges include high relative U.S. energy and labor cost; meeting environmental imperatives; documenting, maintaining, and improving current product quality; developing new processes and products; improved management and utilization of waste and secondary products; etc. The ARS fiber and hide research programs are ideal places to address these challenges faced by their stakeholders. Future research goals will include improving inherent product quality preservation through development of improved harvesting, processing and storage technologies, better quality measurement and grading systems, increased understanding of basic fiber structure and properties, more environmentally friendly modifying and finishing technologies, and new applications and products for U.S. hides, agricultural fibers, and their byproducts.

Problem Statement 2A: Define, Measure, and Preserve Quality

Research Needs

Research is needed to develop new or improved definitions, methods of measurement, and understanding of intrinsic as well as processed fiber and animal hide quality to address issues and provide solutions to preserving, enhancing, and predicting raw and processed fiber and hide quality. Major problem areas include:

- Development of a better understanding of the physical, chemical, and biological aspects that influence fiber and hide quality**,** to include a better understanding of relationships between composition and component molecular structure and how these affect harvesting, processing and end-use quality and function.
- Creation of fiber and hide quality sensing and quantification methods and technologies that are more rapid, accurate, precise, nondestructive, and cost effective than current systems.
- Development of new or improved approaches to monitor and control cotton harvesting, ginning, cleaning, packaging, storing, and textile processing that better preserve fiber quality and generate maximum value to the grower and end user.
- Development of new or improved leather processing and manufacturing methods that are environmentally friendly while maintaining and improving the quality and/or value of leather products.
- Application of new or improved fiber and hide quality definitions to better measure, preserve and/or enhance the value of the by-products during all processing stages.

Anticipated Products

Anticipated and potential products include:

- Quantitative models of fiber and animal hide physical structure that can be used to refine interpretations of relationships between intrinsic quality properties and utility value.
- Methods, definitions, and technologies to rapidly, accurately and economically measure desired quality parameters for quality assessment and process control.
- New or improved equipment and processes that more effectively and efficiently harvest, and process agricultural fibers and by-products from raw material to finished product that will minimize fiber and by-product damage and improve end use value.
- Improved quality assessment criteria and methods for animal hides prior to tanning that will better reflect raw hide and end product value.

Potential Benefits (Outcomes)

- Comprehensive understanding of fiber and animal hide structure will result in final products with increased value and utility.
- Improved quality assessment and process control will improve global competitiveness of U.S. fiber and animal hide producers.
- Reduced fiber and by-product damage during harvesting and processing will result in improved raw material, by-product and end product quality and value.

Problem Statement 2B: New or Improved Technologies, Processes, or Products

Research Needs

There is need for research to create new or improved technologies, processes, or products to address issues and provide solutions to a wide variety of fiber and hide industry problems. Major problem areas include:

- Methods to increase fiber quality and performance that also reduce degradation of fiber quality during harvesting, processing, wear, and care.
- Better systems to grade and classify fiber and hides.
- New analytical measurement technologies and predictive models of fiber and hide quality.
- Methods of adding greater value to fiber and hide products and byproducts through new products, applications and uses.
- Decrease the environmental impact and improve sustainability of all fiber and hide production and processing steps.

Anticipated Products

Anticipated and potential products include:

- New and improved environmentally friendly chemistry for fiber and hide modification, processing, functional finishes, and processing applications.
- Use of fiber in modified or new applications for both woven and non-woven structures as well as non-fibrous forms that will include both durable and non-durable products.
- A better understanding of fiber quality parameters and predicting their effects on woven and non-woven processes and product quality.
- Improved identification and quantification of sources of fiber quality variation, such as inherent genetic properties, production environment, harvesting methods, ginning technology and various post-harvest processing and finishing steps.
- New or improved quality measurement methods, standards, and instrumentation.
- Better methods and understanding for preventing fiber and hide quality deterioration during handling and storage from all causes.
- Better understanding of how changes in animal production and slaughterhouse practices affect the properties of raw hides and their finished products.
- Alternative methods of short-term hide preservation and points of processing will be developed and evaluated in response to environmental concerns and regulations.
- Improved agricultural fiber mechanical harvesting, ginning, and processing equipment and technologies that are more labor and energy efficient and have less impact on raw product quality.
- New or modified processes/techniques for enhancing the value and/or quality of byproducts produced from agricultural fiber and animal hide processing facilities.
- Better and more comprehensive data quantifying environmental impacts of animal hide and agricultural fiber processing.

Potential Benefits (Outcomes)

- New or improved chemistry applications for fiber and hide processing will significantly decrease harmful environmental impacts and industry regulatory issues.
- New or modified fiber and non-fibrous applications will increase the demand for U.S. raw fiber.
- Increased understanding of fiber and hide quality parameters will result in higher quality end products and more efficient markets as raw materials are more exactly matched to end use requirements.
- Improved fiber processing equipment and management practices will result in improved raw fiber quality with decreased environmental impact.
- Better storage and handling practices for agricultural fibers and animal hides will result in more high quality product to market with increased profitability for the industry.
- Improved fiber and hide quality measurement will improve process control efficiency and better maintain inherent quality.
- New technologies that reduce waste and byproducts generated by enhancing their quality and/or value for use in other economically viable applications/processes.
- New products and co-products produced using less energy from various fiber processing streams.

Component 2 Resources

The following ARS locations have research projects addressing the problem statements identified under Component 2:

Stoneville, MS ; Lubbock, TX; New Orleans, LA; Clemson, SC; Wyndmoor, PA; Mesilla Park, NM

Component 3. Biobased Products

Opportunities for the development and use of biobased products is growing in the U.S. because environmentally sustainable products and processes may decrease our dependence on imported petroleum feedstocks and will more fully utilize the vast agricultural resources produced by U.S. farmers and ranchers. New policy incentives, such as the BioPreferred Program administered by the USDA, gives preference to purchase and use of biobased products by government agencies. The goal of Component 3 is to identify and characterize suitable agricultural feedstocks and develop cost-effective technologies that will yield functional industrial and consumer products that satisfy consumer demands in the United States and abroad. These products include non-food, non-fuel industrial and consumer products with cost and performance features comparable or superior to petroleum-based products.

Problem 3A: Agricultural Feedstocks and Byproducts

Processing of agricultural materials annually generates millions of tons of low-value byproducts that represent an enormous and underutilized renewable resource, and can create adverse environmental and economic impacts through disposal. Furthermore, agricultural materials and current processing byproducts can be a sustainable feedstock

for chemicals, polymers, composites, and other industrial materials. New crops grown on under-utilized lands or off-season rotation with commodity food crops can provide materials without affecting our food supply. ARS research will explore potential feedstocks from new and existing crops, agricultural byproducts, and residues and develop processes for conversion to industrial materials, and evaluate quality of crop and agricultural materials.

Research Needs

Understand and exploit the key feedstock characteristics affecting production of chemicals, polymers, and composites, and other industrial materials. Enhance and leverage knowledge of feedstock handling and processing to maximize post-harvest quality.

Anticipated Products

- Improved feedstocks derived from new and existing crops, animal resources, and agricultural byproducts.
- Processes for more efficient use of natural resources that will not disrupt food supply.

Potential Benefits (Outcomes)

- Industrial feedstocks that do not compete with food crop production.
- Improved utilization of agricultural processing coproducts and residues.
- Economic benefit to farmers and ranchers.
- Reduced dependency on foreign oil and other strategic imports.
- Sustainable resources for the chemical industry.

Problem 3B: Develop Biobased Products and Sustainable Technologies/Processes

Lack of fundamental knowledge of biochemical, cellular, molecular properties and processes, and their role in determining functionality has limited utilization of agricultural materials. Sustainable materials and processes that meet functional properties are needed to displace petroleum-based products and create new markets for agricultural commodities and byproducts. Novel products, compounds, and materials are needed for many non-food uses, as specialized products for niche markets. ARS research will enable the development of biobased products from agricultural feedstocks using sustainable processes.

Research Needs

Discover and develop commercially viable biobased materials and conversion processes. Improve biobased material performance and processing through enhanced knowledge of their structure/property relationships.

Anticipated Products

- New processes with reduced environmental impact for converting agricultural-based materials into biobased materials and products.
- Chemicals, polymers, composites, and other industrial materials from renewable agricultural feedstocks

- Bioactive compounds from renewable materials with agricultural applications (e.g., antifungals).

Potential Benefits (Outcomes)

- Lower environmental impact of consumer products.
- Improved cost and performance of biobased products.
- New markets for agricultural commodities and byproducts.
- 'Green' and sustainable processes.

Component 3 Resources

The following ARS locations have research projects addressing the problem statements identified under Component 3:

Albany, CA; Beltsville, MD; Mesilla Park, NM; Lubbock, TX; New Orleans, LA; Oxford, MS; Peoria, IL; Stoneville, MS; Winter Haven, FL; Wyndmoor, PA