

Research Review of National Program NP306: Quality and Utilization of Agricultural Products for the years 2008 - 2012

Review Panelists:

Panel Chair: Dr. Frances Lockwood
SR VP of Research & Development
Ashland Consumer Markets

Panelists:

Professor John W. Finley
Department Chair
Department of Food Science
Louisiana State University

Dr. David Hildebrand
Professor of Plant Biochemistry & Genetics
University of Kentucky

Dr. Stephen W. Searcy, Professor and Chair
Biological and Agricultural Engineering Dept.
Texas A&M University

Jakob Bredsguard
Biosynthetic Technologies
Chief Technical Officer

Review based primarily on the document: NP306 Accomplishment Report 2008 - 2012

Executive summary

The goal of NP 306 is to enhance the value and quality of the agricultural products that consumers need and want by enhancing marketability, creating environmentally friendly and efficient processing, and expanding domestic and global market opportunities through the development of value added foods, fibers and hides, and nonfood byproducts. An assessment by the NP 306 review panel concludes that the research conducted under NP 306 for the years 2008-2012 has substantially supported this goal, with an overall medium to high achievement rating for accomplishments supporting the specific problems defined under the program. The research delivered a highly diversified number of products supporting the program goal, many of which can provide current economic value to existing industrial partners and potential economic impact in the future of hundreds of millions of dollars annually.

The panel rated the project portfolio supporting the component "Biobased Products" as a group to have the highest rating in the program for its current and future high potential, as evidenced by the number of patents filed and by the high engagement of industry in the projects. Products in this category already commercialized by industrial partners include DermCare skin lotions, camelina meal animal feed, biodegradable packaging materials made from cotton ginning trash, and Previda™ prebiotic. Products in process of scale up with good promise of being commercialized by industrial partners include estolide renewable lubricants, synthetic rubber substitutes, pennycress oil crops for biofuels, soy based chewing gum, and biobased surfactants and fragrance. In addition, two projects had potential national importance, a carrier for miticide treatment of honeybees, and biodegradable fire-retardant gels to protect buildings. Continued and perhaps increased investment in this subject area is recommended by the panel.

In the food area the panel rated the project portfolio supporting the problem statements "Defining and Measuring Quality", and "Preserving/Enhancing Quality and Marketability" as medium to high in output of products and impact on scientific fields of study and/or commercial value. Two products already commercialized are rice-based CrispTek "Choice Batter", and Worrell Water Technologies antimicrobial vapor packets for packaged fruit. Wide adoption of the later product is projected to potentially save the fresh produce industry up to \$1 billion annually from postharvest losses. A group of other valuable products developed under this program have been already adopted by industry or are in field testing stage, including ozone fumigation of grapes (adopted), application of phosphites to crops to combat fungus-like pathogens (adopted), carnuba wax – pesticide emulsion spray for citrus (field testing), apple sorting harvesting machine (field testing). These products appear to have potential significant economic value although no figure is reported by ARS. Likewise ARS has conducted extensive work on equipment to measure moisture in almonds, corn and other seeds/nuts both using near infrared (NIR) and microwave, and also equipment to sort individual grains and seeds. These techniques are being tested with industry and appear to have great economic value if adopted and if they are unique. The panel is aware that some very important analytical techniques have been developed by ARS in the past and these efforts seem to be

comparable. However, the question is raised “should ARS develop instrumentation or bring in instrument manufacturers earlier in the process?”. The panel recognized the potentially breakthrough developments and large economic potential, of the projects to reduce scald on apples by a transgenic method and the development of apple, tomato based antimicrobial, edible films. In keeping with the mission of ARS a number of analytical methods/studies developed are also of significant importance to industry, including detection of *Aspergillus* mold on corn and flavor/sensory characterization of tomato.

The panel was less enthusiastic about projects and their product results for problem statement 1c. “New Bioactive Ingredients and Functional Foods” and rated this part of the program medium product output and low impact. A concern was raised that this work supports the supplements industry, e.g. the development of cholesterol lowering material from white grapes, and the commercialization of pterostilbene (ChromaDex pTeroPure TM). The supplements industry is questioned due to lack of medical and long term clinical studies. ARS might consider conducting studies on bulk or whole food materials that have a higher potential return on investment. It can be stated however that ARS enjoys good industry participation in this category as well, including work that developed new strains of strawberries with breeders and growers and the development of oat-based products by Z-Trim Holdings.

For problem statement 1d “New and Improved Food Processing Technologies” the panel rated the project portfolio medium in product output and medium in impact. Several important processing developments were achieved under this part of the program, including; the development and broad commercial implementation by Monterey Mushrooms applying an ultraviolet process to enhance vitamin D content in mushrooms; an ARS-industry-university development utilizing infrared dry peeling of tomatoes and potentially other fruits to replace steam and lye based processes; and a microfiltration process to remove pathogen spores from egg whites. Also, ARS licensed the development of fruit and vegetable edible film technology to NewGem Foods. They projected \$1MM sales of wraps developed with this technology in 2012. The panel discussed the long term benefit of development of emergency food aid – palatability was questioned and therefore the real value. The project to dispose of infected animal tissue was seriously questioned. To dispose of Scrapie infected tissue in this way was viewed as not a good idea – panel believes this material should continue to be incinerated. The potential benefit of this work (reuse of a limited quantity of tissue) would not seem to outweigh the cost (negative public opinion).

For program component 2 “Fibers” the panel rated the product output and impact medium – high. The fiber industry, most particularly the cotton industry, relies heavily on ARS for research and development activities to support innovation in the industry. A very important outcome of the cotton fiber research was a new microwave method to measure moisture in cotton bales. Since the U. S. cotton export market is in the \$5B/year range, with China the largest competitor, maintaining superior quality and reputation of U. S. cotton is important to maintain the U. S. cotton industry. Likewise, work to expand the marketability of cotton is important, and this part of the program had major accomplishments in developing a new process for producing non-woven cotton products for quilting and pillows , now sold

commercially, and producing cotton based sanitary wipes, also now with a commercial partner. The cattle industry is a large part of the U. S. economy, on the order of \$100MM annually,. ARS work to replace toxic chromium treatments for the preservation of leather will alone justify the Fibers component of this program. If change is adopted by the leather industry it must be cost effective and allow the domestic industry to compete with countries with more lax environmental regulations. At this writing the economic potential of the ARS-developed process is unclear, and cost may be the issue. In a similar vein, the ARS process for dehairing bovine hides, being conducted with a major U. S. tannery, holds promise to significantly reduce the environmental impact of tanning. Lastly, a commercial process has been developed by ARS to produce native keratin from wool and the process is being used by a multinational company to develop personal care products. Wool has dropped to historically low values in the U. S. market and as a result become a nuisance for sheep breeders rather than a valuable product. Any effort to restore its value could significantly help the sheep industry in the U. S., which has declined precipitously since the 1940's. Again, the sheep industry is unlikely to produce such innovations without the help of ARS.

As another measure of program productivity, the panel reviewed the publication, patent, and CRADA record of NP306. The overall assessment from Appendix 2 indicates a total of 1,878 publications over the five year period. Over the same time period, the 306 Program has delivered 22 patents ,78 CRADAs, and a number of already commercialized products, indicating moderate - high industrial relevance for the efforts. Viewed from the lens of publications only, the panel estimated a spend of about \$200K/publication, which may appear lower than returns from university funded research, but when viewed in terms of publications per research groups(1 - 6 lead scientists) the publication output during this 5 year period is very good ranging from 1 -77 per group and averaging a little over 5 publications per research group per year. A distribution of publication and patents by component area are shown below. The panel had no knowledge of relative funding of the different component areas, so it may not be surprising that the most highly rated component area showed the best publication/patent outcome, namely, Biobased Products. In contrast, the panels somewhat lower rating of the project portfolio for problem statement 1c "New Bioactive Ingredients and Function Foods" could be questioned based on the good publication and patent record. Overall, the panel was highly supportive of the publication record in high quality journals, and would have liked to have seen a somewhat better patent ratio.

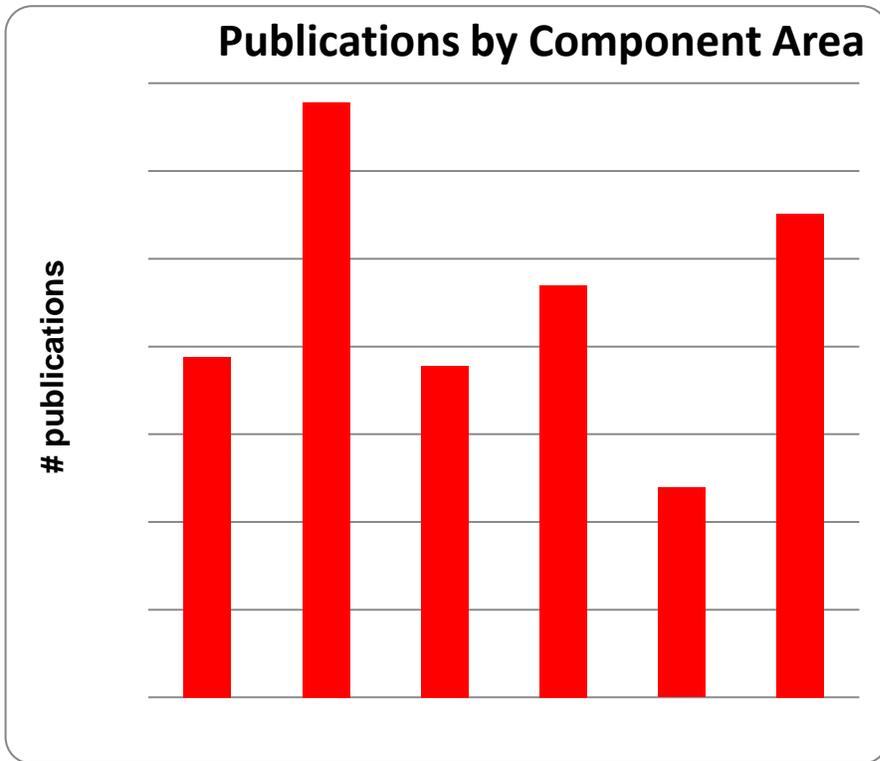


Figure 1. Publications by component area.

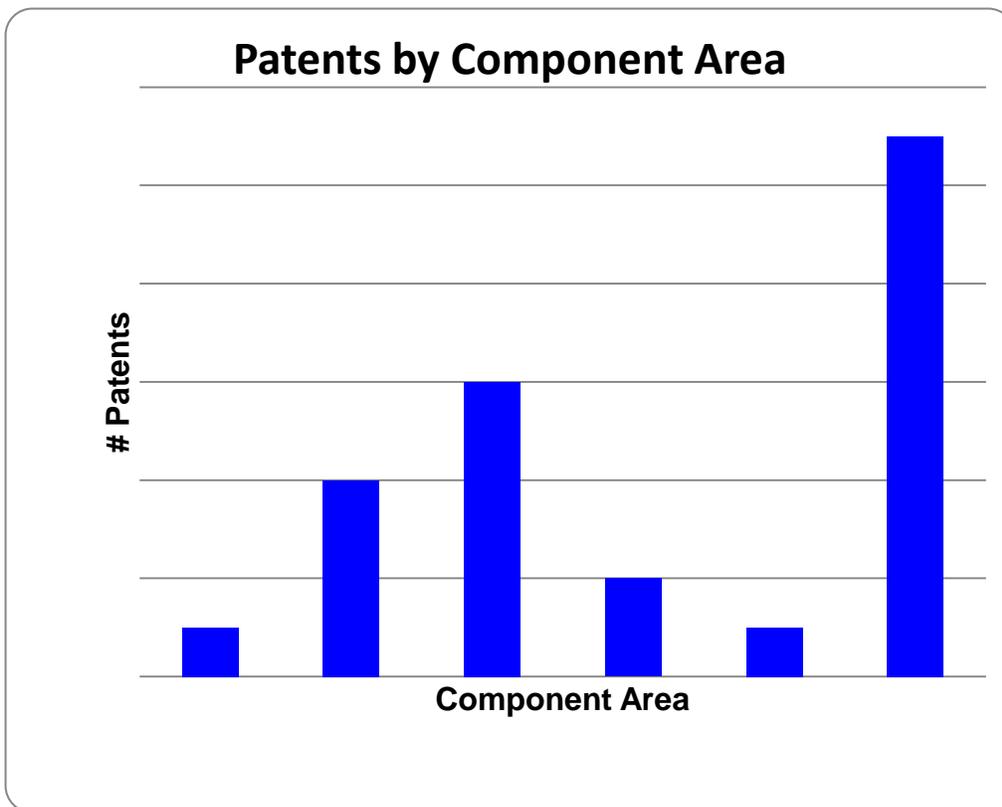


Figure 2. Patents by component area.

In conclusion, the panel was highly appreciative of the work being done in program NP306 and would encourage additional work in component “Biobased Products”. The panel thanks the ARS team, particularly Tracy Havermann, for support of the review effort. Details of the panel assessment are given below.