IMPROVING RURAL ECONOMIES THROUGH NEW USES OF AGRICULTURALLY-BASED MATERIALS

ARS research enhances the economic viability and competitiveness of U.S. agriculture by improving the quality and marketability of harvested foods and agricultural feedstocks to meet consumer needs while developing environmentally friendly and efficient processing concepts. The development of new agriculturally based materials is beneficial to farmers, consumers, and retailers because they are environmentally friendly, improve utilization of crops, and enhance economic security for rural communities. The following accomplishments in 2021 are examples of how ARS researchers develop these products.

Environmentally friendly "green" plastics as packaging materials. Poly(3-hydroxybutyrate-co-3-hydroxyvalerate) (PHBV) and polyhydroxyalkanoates (PHA) are considered promising "green" alternatives to fossil fuel-based synthetic polymers such as nylon, polyethylene, and polyester used to make plastics. PHBV and PHA are made by bacteria and are compatible with living tissues, and unlike fossil-fuel based plastics, they are biodegradable. PHAs have similar properties as plastics with good moisture/aroma transport properties, but they tend to be more brittle and stiffer. PHBV polymers are less stiff and tougher, making PHBV ideal for packaging materials. The properties of a PHBV blend depends on its composition, which can be analyzed by nuclear magnetic resonance (NMR). ARS scientists in Peoria, Illinois, developed an improved NMR method for determining PHBV structure that provides enhanced informatics on PHBV structural accuracy. This knowledge helps determine the structural relationships used for making better PHBV plastics, especially for packaging, orthopedic devices, and in controlled release of drugs.

> **ARS scientists used ARS-created estolides made from sunflower and soybean oils to develop a new type of engine oil additive that solves engine lubrication problems.**

A bacteria-based biopesticide controls pecan weevil and preserves natural enemies. The pecan weevil is a major pest of pecans and is typically controlled with chemical insecticides. However, these insecticides may be harmful to humans and the environment, kill beneficial natural enemies such as lady beetles, and boost numbers of pecan aphids, another group of major pecan pests. An environmentally safe biopesticide, "Grandevo", based on a naturally occurring bacterium that was discovered by ARS scientists in Beltsville, Maryland, was tested on pecans by ARS scientists in Byron, Georgia. It produced equal levels of pecan weevil control compared with commonly used chemical insecticides. Furthermore, the biopesticide contributed to pecan aphid control and did not harm beneficial natural enemies during field experiments. ARS scientists determined the bacteria-based biopesticides are a viable, eco-friendly tool for the control of pecan weevils in both organic and non-organic production systems.

Improved catalyst for biofuel production from vegetable oils. The transformation of vegetable oil into a material that can be directly used as a replacement for fossil-based oil is a difficult technical process. However, ARS scientists in Peoria, Illinois, developed a new catalyst made from recycled iridium chloride previously used in industrial and medical applications. Using this technique, a biofuel can be made from fatty acids naturally found in plants. This new biofuel produces a higher-value biofuel than fuels made using other technologies, meets standard specifications, and keeps fuel system seals pliable and elastic. This new vegetable-based, catalyst-derived biofuel is a sustainable replacement for fossil fuels when used alone or in combination with fossil fuels to produce high value blends. ARS has patented this technology.

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Green jet fuel from yeast now at commercial scale. U.S. airlines have committed to reducing carbon dioxide emissions by 50 percent in 2050, which has generated significant demand for renewable jet fuel that can be used to replace the 23 billion gallons of fossil fuel currently supplying the jet fuel market. ARS scientists in Peoria, Illinois, assembled a collection of yeasts that convert agriculture waste into bio-oil, which is then easily converted into biodiesel or renewable jet fuel. One of these yeasts (Rhorosporidium toruloides) was used in a pilot demonstration at a commercial development center to convert sugarcane bagasse into bio-oil. The yeast produced 18 grams of bio-oil/100 grams of agricultural waste, demonstrating that it is robust enough to produce bio-oil in a commercial, large-scale operation

Cheung, Lance. Agriculture Secretary Tom Vilsack greets researchers, members of Congress, and passengers of Alaska Airlines Flight 4, celebrating the first commercial flight powered in part by wood-to-jet fuel from Washington state to Reagan National Airport, Washington, D.C., on Monday, Nov. 14, 2016. USDA Photo. https://flic.kr/p/NKMcmG