# Fats, Oils and Animal Coproducts Research Unit
# Eastern Regional Research Center, Wyndmoor, Pennsylvania

**William N. Marmer, Research Leader**
william.marmer@ars.usda.gov; 215-233-6585

*Current research projects and objectives; Lead SY's and contact information*

**Production of value-added lipids, biofuels, and biobased products from fats and oils *[including BIODIESEL and GLYCEROL UTILIZATION]***

Thomas A. Foglia (LS): thomas.foglia@ars.usda.gov; 215-233-6480
Michael J. Haas (LS, 10/1/07): michael.haas@ars.usda.gov; 215-233-6459
Victor T. Wyatt: victor.wyatt@ars.usda.gov; 215-233-6674

**Objective 4, Biofuels and additives**: Develop alternative processes for producing biodiesel from intact oils and fats and/or less expensive lipid feedstocks. Develop methodologies for improving the quality and performance of biodiesel fuels.

**Objective 5, Glycerol utilization**: Convert glycerol to prepolymers for prospective use in the synthesis of polyesters and polyamides or for use as polydispersants.

**Integrative processes for the bioconversion of fats, oils and their derivatives into biobased materials and products *[including GLYCEROL UTILIZATION]***

Daniel K. Y. Solaiman (LS): daniel.solaiman@ars.usda.gov; 215-233-6476
Richard D. Ashby: rick.ashby@ars.usda.gov; 215-233-6483
Jonathan Zerkowski: jonathan.zerkowski@ars.usda.gov; 215-233-6515

**Objective 1, Production of bioproducts via fermentation**: Develop fermentation-based bioconversion systems that utilize renewable and cost-competitive agricultural fats, oils and coproducts as feedstocks to produce value-added biobased products and materials with enhanced properties and minimal environmental footprints.

**Objective 2, Modification of fermentation-produced bioproducts:** Explore the modification of the isolated microbially produced biomaterials such as surfactants and biopolymers to improve their physical and chemical properties for alternative end uses and/or conversion to secondary value-added co-products. Develop and characterize end-use consumer products using as ingredients the native or modified biomaterials.

*Key accomplishments (See handout for more details on the research highlights)*

***Alternative feedstocks and production technologies****: Most of the cost of biodiesel is in the feedstock. There are abundant low-cost alternatives to refined vegetable oils that—with application of appropriate technology—can fill America's growing demand for the fuel.*

- *In situ* (direct) transesterification: Conceived, and are developing, a new method ('in situ transesterification') for the direct synthesis of biodiesel from lipid-bearing materials such as soy flakes, DDGS, and meat & bone meal.
- Biodiesel from soapstock
- Low value refined lipids as biodiesel feedstocks: rendered fats & oils, used cooking oil
- Waste-stream lipids such as restaurant trap grease and the technology for their conversion to biodiesel
- Renewable catalysts such as immobilized enzymes and heterogenous acids and bases for biodiesel production

- Process simulation and cost engineering of biodiesel production

*Key accomplishments, continued (See handout for more details on the research highlights)*

***Fuel properties**: $NO_x$ emissions have been the one property of biodiesel that has challenged claims of the environmental benefits of this fuel. The problems have been most identified with the extent of unsaturation in the fuel and feedstock; soy oil, with its high polyunsaturation, was particularly vulnerable to this challenge.*

- $NO_x$-reducing fuel additives for biodiesel
- Chemical modification of the biodiesel to alter physical properties or reduce unsaturation

***Biodiesel quality—meeting industry specifications**. The biodiesel industry is very sensitive to the need for quality products. It has set its own standards and promoted those of ASTM. Accurate yet simplified analytical techniques are needed for lab and field assays. Newly surfacing problems with trace impurities have also demanded more specific test methods.*

- Identified species present in biodiesel samples from engine failure events.
- Developed rapid methods for measuring biodiesel fuel quality and blend levels

***New markets for glycerol byproduct of biodiesel production**. Rising production of biodiesel has meant a growing glut of the glycerol (glycerin) coproduct and thus a growing urgency for new uses for the material.*

- The use of crude biodiesel glycerol as a carbon and energy source in the microbial production of polymers and surfactants
- Synthesis of hyperbranched glycerol-diacid copolymers for bioremediation of waste water streams.
- Incorporation of biodiesel glycerol into new adhesive and elastomer products.

***Intact oils as burner fuel.** Biodiesel's focus has been for use in vehicular engines. Stationary heaters (boilers, etc.) also use petroleum products and alternatively could burn not only biodiesel but--with appropriate engineering—intact oils and fats as well.*

- Investigating intact triglycerides, particularly used cooking oils, as burner fuels.

***A source of technical expertise**: Our scientific and managerial staff have been invited to lend their expertise to numerous public meetings, citizen's group events, and stakeholder/customer workshops.*

*Other scientific expertise or capabilities already available to the RU that could be applied to bioenergy research*

- Broad expertise – chemistry, biochemistry, microbiology, molecular biology, materials engineering – in the conversion of lipid-bearing materials, hides, wool, and rendered protein to value-added bioproducts

- Well established international network with other researchers in the field, other research locations (including NCAUR), and the stakeholder/customer base

- Instrumentation such as small diesel engine with emission monitors, analytical test instrumentation (GC, HPLC, LC/MS, mechanical testers, fermentors), and ERRC core facilities (genomics/proteomics with MALDI-TOF-TOF, microscopy, NMR).