## Accomplishments *(continued)*

- Developed technology for using poultry blood as a biobased flocculant
- Developed animal protein-based substitute feedstocks for industrial fermentations
- Improved technology for ash-protein fractionation of meat &bone meal (MBM)
- Demonstrated susceptibility of prions to inactivation by processing
- Surveyed engineering properties of MBM produced nationwide
- Rhamnolipid biosurfactant production by non-pathogenic organism in an energy-saving process
- Developed novel rapid and specific PCR methods to detect, clone and characterize genes for bioplastic synthesis and degradation
- Developed the use of inexpensive and surplus glycerol, soy molasses and other coproducts for the production of bioproducts
- Novel oleochemicals and tailor-made functional fluids from renewable microbial biosurfactant
- Methods of improving shrink-resistance of natural fibers, synthetic fibers, or mixtures thereof, or fabric or yarn composed of natural fibers, synthetic fibers, or mixtures thereof (U.S. Patent 7,090,701)
- Methods of inhibiting the burning of natural fibers, synthetic fibers, or mixtures thereof, or fabric or yarn composed of natural fibers, thereof, and products produced by such methods (U.S. Patent 7,264,637)
- Chemical and enzymatic modifications of wool keratin
- New keratin products from wool

## ARS Mission

The Agricultural Research Service conducts research to develop and transfer solutions to agricultural problems of high national priority and provides information access and dissemination to

- ensure high-quality, safe food and other agricultural products;
- assess the nutritional needs of Americans;
- sustain a competitive agricultural economy;
- enhance the natural resource base and the environment; and
- provide economic opportunities for rural citizens, communities, and society as a whole.

## Contacts

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USDA

United States Department of Agriculture
**Agricultural Research Service**
**Eastern Regional Research Center**

# Biobased and Other Animal Coproducts Research Unit

**Cheng-Kung (C.-K.) Liu, Ph.D.**
Research Leader


## Mission

Using chemical and biotechnological principles, environmentally friendly methods are developed to increase the value and use of domestic fats and oils, hides, wool, and other animal co-products. Research is conducted on the following:

- Hides and leather research supports the environmentally sound utilization of the most valuable coproduct of the meatpacking industry and its conversion into leather and other valuable products;
- Wool research opens new markets for the co-product of the lamb and mutton industry by developing improved textiles and by converting wool protein into new biobased products;
- Rendered products research develops non-feed applications for meat & bone meal and related products;
- Biosurfactants and biopolymers research adds value to animal fats, plant oils and co-processing products by developing commercially viable, environmentally friendly microbial bioproducts and derivatives.

## Accomplishments

- Molecular model of collagen microfibril
- New uses of surplus agricultural proteins as biopolymer fillers for leather
- Developed genipin tanning and genipin-modified gelatin products as fillers
- Non-sulfide unhairing processes
- Novel analytical techniques for the detection of decorin in hides
- Established optimum drying process for chrome-free leather
- Leather finishing with natural antioxidants for enhanced leather durability
- Nondestructive evaluation methods for leather

## Biosurfactants/Biopolymers Research

CRIS Project: *1935-41000-090*
Production and Value Enhancement of Biosurfactants and Biopolymers Derived from Agricultural Lipids and Coproducts
**Lead Scientist:** Daniel Solaiman

### Research Program:

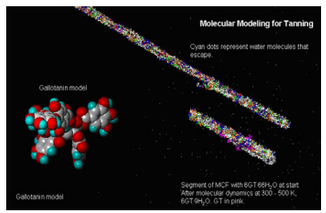
- **Microbial biobased products**
  - Ecologically sound biosurfactants (rhamnolipids, sophorolipids)
  - Biodegradable polymers (cyanophycin, poly-γ-glutamic acid, poly(hydroxyalkanoates))
  - Value-added derivatives (novel polyols, oligoamides, "clickable" fatty acids, estolides, "Hi-Sol" sophorolipids)
- **Fermentation feedstocks**
  - Animal fats (tallow, lard, chicken fat, yellow grease)
  - Plant oils (soybean oil, sunflower oil, "new-crop" oils - *cuphea, lesquerella*)
  - Coproducts (bioglycerol from biodiesel, soy molasses, meat & bone meal, cellulosics)
- **Multidisciplinary technology platform**
  - Molecular biology (genetic cloning, modification, expression, knock-out)
  - Microbiology (feedstock manipulation, Response Surface Methodology optimization)
  - Chemistry ("clickable" chemistry, biomolecule conjugates)

## Hides and Leather Research
(supported by on-site tannery)

CRIS Project: *1935-41440-019*
Environmentally Friendly Processes and New Applications for Animal Hides and Leather
**Lead Scientist:** Cheng-Kung Liu

### Research Program:

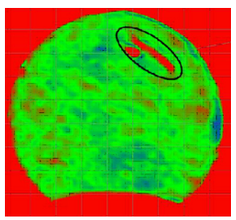
- **Removal of manure using recycled crude glycerol and biobased surfactants**
- **Unhairing of hides without sulfides**
- **Mechanism of tanning**
  - Molecular modeling of collagen-I
  - Finding new chrome-free tannages

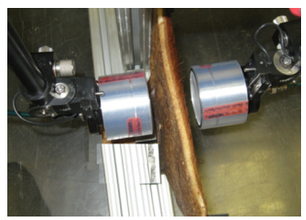



- **Enzymatic and chemical crosslinking**

  - New applications for collagenous tannery waste
    - fillers, coatings

- **New products derived from hides**
  - Films, air filters, and green composites
- **Airborne ultrasonics for nondestructive testing**





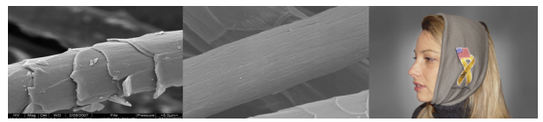
## Wool Research

CRIS Project: *1935-41440-020*
Wool and Keratin from Wool for Biobased Value-Added Products
**Lead Scientist:** Jeanette Cardamone

### Research Program:

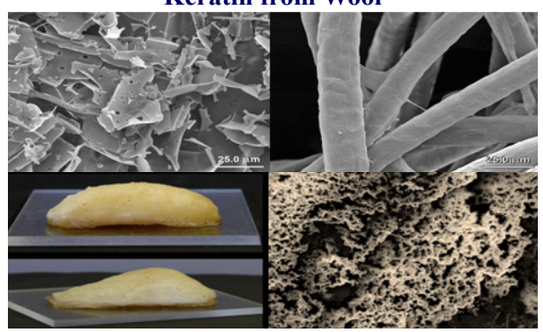
**Chemical and Enzymatic Modifications of Wool Keratin**

- **Biopolished, washable wool**
  - *ARS Process* (U.S. 7,090,701)
  - Fiber surface alteration
  - *Flame retardancy* (U.S. 7,264,637)



- **Keratin product development**
  - Extraction and derivatization
  - New product development
  - Keratin protein applications
    - powder
    - microfiber
    - brushes
    - scaffold
    - microemulsion
    - sponge

**Keratin from Wool**




## Animal Byproduct Proteins Research

CRIS Project: *1935-41440-021*
Characterization, Processing and Novel, Non-Feed Uses for Proteinaceous Rendering Byproducts
**Lead Scientist:** Rafael Garcia

### Research Program:

- **Animal processing byproducts**
  - Protein meals, unprocessed blood


- **New applications**
  - Flocculants
    - erosion control
    - paper slurry dewatering
    - mine tailings treatment
  - Industrial fermentation feedstock
    - oil-producing algae and fungi
    - biopolymer-producing bacteria