

# BMB Active Site News

Est. 1968

Fall 2020

## Message from the Department Head



The COVID-19 pandemic affected K-State and our department, just like it did the rest of the world. Our students left the campus for spring break, not knowing that their return to classes and laboratories would be delayed for months. Two days before the end of spring break in March 2020, the university decided to transition to online instruction, which was followed by a complete shutdown of the campus, with only few essential activities remaining. The BMB courses continued on the Internet while our research laboratories went into hibernation. All those steps were dictated by the need to stop the spread of coronavirus in the Manhattan community. Due to COVID-19, the graduating class of spring 2020 was deprived of a joyful commencement ceremony.

Our research activities resumed gradually in June, with strict social distancing measures. Face masks became mandatory in KSU buildings. All graduate defenses, seminars, meetings, and discussions were being held online. But, our research efforts continued throughout summer, including installation of the new NMR spectrometer you can read about in this newsletter.

The fall semester began earlier than usual, on August 17. We teach biochemistry courses using a number of different approaches. Some courses are taught with the instructor and students present in the classroom. Social distancing with health and safety rules are strictly enforced in such courses. Other courses use online instruction. Teaching laboratory courses is especially challenging for the instructors, teaching assistants, and students. We are working hard to fulfill our missions as the K-State academic and research hub of molecular life sciences.

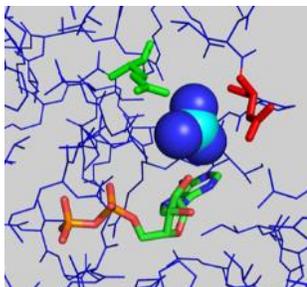
We hope our Alumni and Friends stay healthy and strong, and we send our greetings from Manhattan to all!

Michal Zolkiewski

## Dr. Zolkiewski Leads Team in Discovery of Novel Antibiotics

In summer 2019, Michal Zolkiewski, professor and head of the BMB department, was awarded a four-year \$1.9 million-plus grant from the National Institutes of Health to develop new antibiotics. Zolkiewski will lead a team of investigators that includes the members of his laboratory at K-State and collaborators from the University of Kansas in Lawrence.

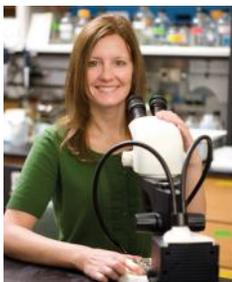
Decades of global antibiotic misuse and overuse, along with a lack of commercial incentives to develop new drugs, have brought us to a point where antimicrobial resistance is a major threat to human health. According to the Infectious Disease Society of America, at least 2 million Americans each year develop infections from antibiotic-resistant pathogenic microorganisms and about 25,000 of them result in death. Thus, a development of novel antimicrobial strategies and the discovery of new antimicrobials are highly relevant to global public health.



The Zolkiewski research group has been at the forefront of studies on the biological function and biochemical mechanism of a bacterial protein called ClpB. In bacterial cells, ClpB helps other proteins maintain their activity and its role is particularly important in pathogens during infection of a host. Zolkiewski hypothesizes that ClpB could become a promising target for new antibiotics, which would exploit a previously unexplored vulnerability of pathogens: a need to protect the quality of their proteins during infection.

With support from the new NIH award, Zolkiewski and his colleagues will search for chemical compounds that inhibit ClpB and suppress bacterial growth. The collaborative effort will leverage the protein biochemistry expertise in the Department of Biochemistry and Molecular Biophysics at KSU and KU's prominence in pharmaceutical chemistry and drug development. The studies could eventually bring new antibiotics to the market and also provide useful information on pathogen-host interactions during infections.

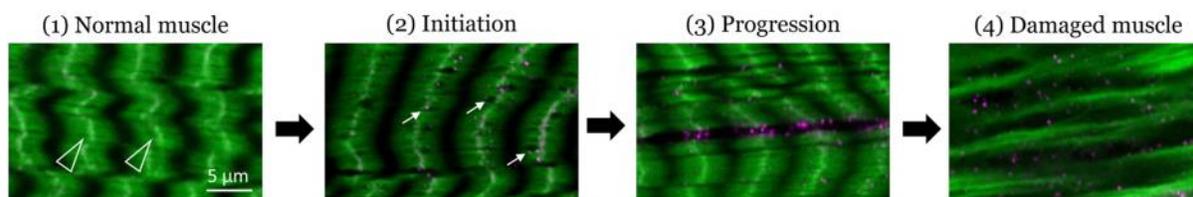
## Dr. Erika Geisbrecht Awarded NIH Grant to Study 'Mechanisms Underlying Muscle Development and Maintenance in *Drosophila*'



A 5-year RO1 research grant, sponsored by the National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS) under the National Institutes of Health, was awarded to Erika R. Geisbrecht in February 2020. This \$1.6 million grant is a renewal of a project entitled, 'Mechanisms Underlying Muscle Development and Maintenance in *Drosophila*' that started in 2012.

Broadly, the Geisbrecht lab, part of the Karen Nickel Biochemistry Laboratory in Burt Hall, renovated through the generosity of Karen Nickel (1966 M.S./1968 Ph.D. in Biochemistry), studies how muscles develop and how healthy muscle tissue is maintained, especially in the context of preventing muscle loss and slowing disease progression. All cells in the body must strike a balance between making new proteins (protein synthesis) and getting rid of old or damaged proteins (protein degradation). A failure to clear damaged proteins may result in the abnormal accumulation, or aggregation, of proteins within cells. It is well established that a failure to clear protein aggregates within cells results in neurodegenerative diseases (e.g., Alzheimer's, Parkinson's, Huntington's). However, protein aggregation is understudied in the context of muscle disease.

The Geisbrecht lab has established a genetic platform in the model organism *Drosophila melanogaster*, or the fruit fly, to understand how protein aggregates form and how a failure to clear these aggregates result in cellular degeneration. *Drosophila* offers unique advantages to understand how protein aggregation cause muscle degeneration. First, fruit flies have a short life cycle that allows for faster data collection than other vertebrate genetic models. Second, the *Drosophila* larval muscles are structurally and molecularly similar to human muscle, allowing for the initiation and progression of protein aggregation to be visualized using microscopy. Since approximately 80% of human disease genes have counterparts that perform similar functions in the fruit fly, the Geisbrecht lab can study how mutations in human patients who suffer from a group of protein aggregate diseases termed myofibrillar myopathies (MFM) affect muscle function.



## New NMR Spectrometer at Mary L. Vanier Biomolecular NMR Facility

Nuclear Magnetic Resonance (NMR) Spectroscopy is a powerful technique used in a broad range of disciplines including biochemistry and structural biology. NMR is the only viable approach for determining three-dimensional structure of biological macromolecules in solution and for assessing the dynamic motions of biologically active proteins.

The new spectrometer equipped with state-of-the-art cryogenic probe will enable our students and researchers to perform cutting-edge studies on protein structure and dynamics and answer questions on how proteins fold into their active shapes, how they interact with each other and with other molecules within cells, and importantly, how their structures are altered in human diseases, including cancer.



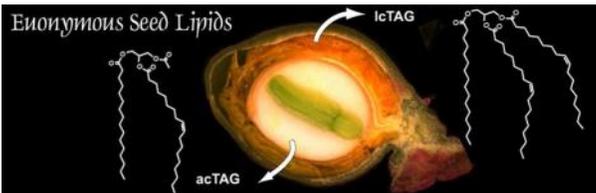
The new 14 Tesla 600 MHz NMR system, made by Bruker Bio Spin in Switzerland, has now become the centerpiece of the Mary L Vanier Biomolecular NMR Center in the Department of Biochemistry and Molecular Biophysics. The instrument purchase (~\$950,000) was funded with the NIH award to Professor Om Prakash and a support from the KSU Vice President for Research, KSU Johnson Cancer Research Center, Kansas Agricultural Experiment Station, the Deans of the colleges of Arts & Sciences, Veterinary Medicine, and Engineering, KSU Graduate School, and the Department of Biochemistry and Molecular Biophysics. The new NMR spectrometer will be available to all researchers on campus as well as to researchers from other institutions through scientific collaborations.

If you are in the Manhattan area, please contact the department to schedule a visit of our new NMR spectrometer in the basement of Chalmers Hall!

## USDA Funds Effort to Increase Triacylglycerol Molecules in Plant Oils

Vegetable oils consist of triacylglycerols, molecules that possess a glycerol backbone that is connected to three fatty acids. The types of fatty acids present in the triacylglycerol molecules affect the physical and chemical properties of the vegetable oil.

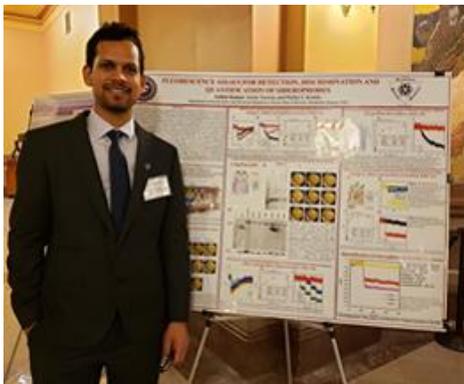
Research in the laboratory of Associate Professor Timothy Durrett aims to modify the fatty acids incorporated into triacylglycerol molecules in order to generate vegetable oils with targeted properties useful for specific applications. The work takes advantage of the fact that throughout the plant kingdom, various species produce triacylglycerols with unusual fatty acids that impart useful properties. In particular, his research has focused on the production of acetyl-triacylglycerols, unusual triacylglycerols that possess a short acetate group instead of a fatty acid. These unusually structured lipids are produced by a number of different species, including the Burning Bush shrub (*Euonymus alatus*). Vegetable oil comprised acetyl-triacylglycerols possesses a lower viscosity and improved cold temperature properties, making it ideal as an improved direct-use biodiesel. Because the plant species that produce acetyl-triacylglycerols are not suitable for cultivation as crops, the Durrett group has used genetic engineering strategies to transfer genes from different *Euonymus* species into oilseed crops. They primarily use the oilseed crop *Camelina sativa* as a chassis for their metabolic engineering strategy because the plant is easy to transform and is not used as a source of vegetable oil for human consumption. Work in the Durrett group has produced camelina lines where up to 90% of the oil is comprised of acetyl-triacylglycerols.



A recently awarded grant from the United States Department of Agriculture will enable Durrett and his group to pursue the goal of generating camelina seeds that produce 100% acetyl-triacylglycerols by optimizing the timing and localization of acetyl-triacylglycerol production in the transgenic seeds. Using genome editing and RNA-interference strategies, they will also target endogenous

lipases that might degrade acetyl-triacylglycerols. A collaborator on the project, Dr. Young-jin Lee in the Department of Chemistry at Iowa State, will use mass spectrometry imaging of the transgenic camelina seeds to identify specific regions that accumulate acetyl-triacylglycerols. In addition, Dr. Umut Yucel, in the Food Science Institute/Department of Animal Sciences and Industry at K-State, will characterize the physical and chemical properties of acetyl-triacylglycerols to identify new applications and markets for these molecules.

## BMB Graduate Student Receives Awards as Outstanding GRA and GTA.

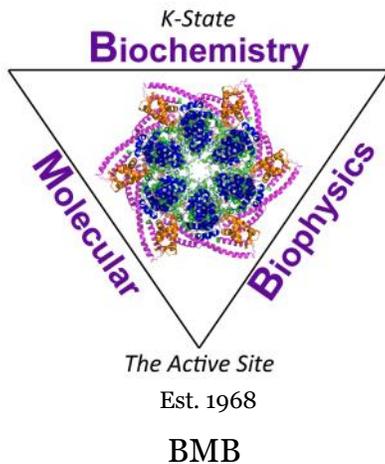


After winning top honors and a scholarship at Research and the State on October 31, 2019, Ashish Kumar, doctoral student in biochemistry, was one of 10 representatives of K-State at the 17th annual Capitol Graduate Research Summit on February 26, 2020, at the State Capitol in Topeka. He presented his poster "Fluorescence Assays for Detection, Discrimination and Quantification of Siderophores" and discussed the implications his work has on issues in the state of Kansas with state legislators, members of the Kansas Board of Regents, and the public. Kumar received awards sponsored by MO Valley PDA and BioKansas. Kumar's faculty advisor is Dr. Phillip Klebba, university distinguished professor of biochemistry and molecular biophysics.

Kumar is also the 2020 recipient of the Presidential Award for Excellence in Undergraduate Teaching, sponsored by the university president's office and Curtin Property Company, a real estate development firm with offices in Manhattan and Kansas City. Philip Klebba, university distinguished professor of biochemistry and molecular biophysics, nominated Kumar for this distinguished award. Kumar has worked as a graduate teaching assistant with Klebba for several semesters.

K-State Biochemistry and Molecular Biophysics was also proud to award Ashish Kumar both of the Charlie Hedgcoth, Jr. and Phillip Nordin Graduate Memorial Awards for Excellence in 2019. He earned one for excellence in graduate research and one for excellence in graduate teaching. Each award came with a moderate scholarship.

*Photo courtesy of K-State News.*



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## Michael Kanost Recognized with Commerce Bank and W.T. Kemper Foundation Distinguished Graduate Faculty Award



**M**ichael Kanost, university distinguished professor of Biochemistry and Molecular Biophysics and nationally recognized expert in insect biochemistry, is one of two recipients this year for Kansas State University's Commerce Bank and W.T. Kemper Foundation Distinguished Graduate Faculty Award. He will receive an honorarium for his excellence in mentoring and teaching of graduate students and in research. The award, Kansas State University's top honor for graduate teaching and research, recognizes current members of the graduate faculty who are respected nationally and internationally for their outstanding scholarly achievements and for their contributions to graduate education at the university.

Kanost's research has focused on biochemistry and immunology of insects, including functions of hemolymph plasma proteins and hemocytes in immune responses, biochemistry of insect exoskeletons, and functions of insect multicopper oxidases. With the help of his laboratory, he also coordinated the annotation of the recently sequenced genome of the tobacco hornworm, *Manduca sexta*, an important model species for insect research.

Kanost has served as major professor for 14 doctoral and nine master's students and has served on 105 graduate student committees. He has mentored 21 postdoctoral scientists, 42 undergraduate students and 11 visiting scientists in research. He teaches biochemistry courses from the 100 to 900 level. *Photo courtesy of K-State News.*

- ◆ KSU Biochemistry & Molecular Biophysics On the Web: <https://www.k-state.edu/bmb>
- ◆ Connect with K-State Alumni Association: <https://www.k-state.com>
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