New Research Could Lead to More Effective Chemotherapy

The two recent Cover Articles from the Beyzavi Lab are featured in KNWA TV Channel, FOX24 TV Channel, and University of Arkansas News.

An international team of researchers led by Dr. Hassan Beyzavi of the University of Arkansas is studying the use of platinum and gold to enable more effective forms of chemotherapy. “Biological importance of platinum complexes in medicinal chemistry has attracted considerable attention due to the wide-spread therapeutic activities of cisplatin,” the researchers said. “However, the anticancer properties of cisplatin are believed to be limited by major drawbacks, including intrinsic or acquired resistances and several toxicities.”

Beyzavi, an assistant professor in the Department of Chemistry and Biochemistry at the University of Arkansas, explained that new platinum- and gold-based drug candidates could lead to therapies that are more effective and less prone to resistance than cisplatin, which means patients could take lower doses, minimizing the risk of side effects. He said that another goal of this research is to expand the scope of cancer cells that can be targeted.

The researchers used computer simulations to design several different platinum-based molecular structures and test how these anti-cancer agents would bind to the DNA of cancer cells.

After the researchers had identified several promising molecular structures, Beyzavi synthesized the platinum and gold complexes. His collaborators then tested these drug candidates in the laboratory, exposing them to human lung, ovarian and breast cancer cell lines. Experimental results showed that these molecules were able to induce natural cell death by binding to the DNA of cancer cells. They then compared these new drug candidates to cisplatin and found that three of them were significantly more effective.

The team recently published their findings in the New Journal of Chemistry and Applied Organometallic Chemistry. Their articles were featured on the Cover of both journals.

Learn more about Beyzavi Lab at https://beyzavigroup.uark.edu/
Faculty News

On the Go


Colin Heyes attended the Gordon Conference on Protein Transport across Cell Membranes in Galveston, TX from March 11th-16th and presented a poster, “Protein Targeting to the Cell Membrane” authored by Manso, R.H.; Song, L.; Liang, Z.; Wang, J.X.; and Chen, J.

Colin Heyes presented a talk, “Interfacial Control of Colloidal Heteronanostructures to Control Single Particle Emission in Cd-based and Culn-based Chalcogenide Quantum Dots.”

Matt McIntosh presented a talk, “The Oka Fragmentation of the Breslow Intermediate is a Radical Process.” Posters presented were:

FRED Based Assays to Study the Binding and Regulation of FGF to its Receptor (FGFR).

Mamello Mohale, Ashley Howard, T.K.S. Kumar, and Colin Heyes.

Bioconjugation of CulnS2/ZnS Quantum Dots to FGF and Bioimaging their Interactions with FGFR.


Structural Changes of Chloroplast Signal Recognition Particle Proteins Studied by Single Molecule FRET During Vectorial Protein Targeting.

Dustin Baucom, Rory Henderson, Robyn Goforth, Alicia Kight, Priyanka Sharma, Feng Gao, Suresh Kumar, Ralph L. Henry, and Colin D. Heyes.

Synthetic Control over Structural and Optical Properties of CulnS2/ZnS Quantum Dots.

Anh Nguyen and Colin D. Heyes.

Two-step Derivatization of Fluconazole via Radical Fragmentation of a Breslow-type Intermediate.

Jacklyn Kubik, Charles Moon, Juliette Rivero, Jordan Avery, Cody Canote, Jessica Sonnentag, David McNabb, and Matt McIntosh.

Novel 5-coordinate and 6-coordinate low-valent molybdenum (VI)-dioxo complexes exhibiting deoxydehydration activity.

Randy Tran, Stefan Kilyanek.

This poster was selected for the SciMix program.

Computational investigation of the mechanism of metal-oxo catalyzed deoxydehydration.

Kayla A. DeNiece, Stefan M. Kilanek.

The influence of ligand environment on the deoxydehydration of polypyrroles by metal-oxo complexes.

Stefan M. Kilyanek, Randy Tran.

The department was well represented at the 62nd Annual Meeting of the Biophysical Society February 17-21, 2018 in San Francisco, California, with six abstract presentations.

Ionization and Dynamic Properties of Single and Multiple Histidine Residues on a Transmembrane Helical Backbone.

Fahmida Afroze, Denise V. Greathouse, Roger E. Koeppel II.

Detection of Helix Fraying of a Transmembrane Peptide with Two Interfacial Arginine Residues.

Sara Sustich, Fahmida Afroze, Denise V. Greathouse, Roger E. Koeppel II.

Analyzing the Effects of Placing Central Arginine Residues within a Highly Dynamic Transmembrane Alpha-Helix.

Matthew J. McKay, Denise V. Greathouse, Roger E. Koeppel II.

Influence of Saturation and Hydrophobic Length of Lipid Bilayers on Twin-Arginine Containing Helical Pep-

tides.

Karl A. Lipinski, Ashley N. Martfeld, Denise V. Greathouse, Roger E. Koeppel II.

Gramicidin Subunits that Cross Membranes and form Ion Channels.

Matthew Brown, Matthew J. McKay, Denise V. Greathouse, Olaf S. Andersen, Roger E. Koeppel II.

Dissecting Drug Physico-Chemical Profiles as They Relate to their Bilayer Modifying Potency.

Radda Rusinova, Roger E. Koeppel II, Olaf S. Andersen.

Publications


Rajesh Thapa and Prof. Stefan Kilyanek filed a patent on their new flusional ligand systems for Pd catalyzed C-C cross-coupling reactions. These unique catalysts have a variety of application across d8 platinum-group metal catalysts. These macrocyclic ligands were designed to afford rapid changes in the second coordination sphere of the metal.
From the Chair ~ Wesley Stites

In the course of looking for some other records, we discovered some history of the department we thought you might find interesting. Specifically, Dr. Charles Geiger Carroll, one of the early faculty, passed away just over 100 years ago and he was the subject of obituary notices in the Fayetteville Weekly Democrat, The Journal of Industrial and Engineering Chemistry, and The Johns Hopkins Alumni Magazine. It is amazing to read of his career.

Dr. Carroll was born on October 15, 1875 in Ashland Kentucky, but, his father a Methodist minister, moved frequently and grew up primarily in West Virginia and Colorado. At the age of 15 he entered the University of Denver, where he remained for one year. The next three years he spent teaching in Texas. In 1895, he began studies at Southwestern University and earned a BA in 1896 and an MA in 1897. He remained at Southwestern as an instructor in languages and science. Yes, that is correct, languages with an S. He taught Latin, English, French, Chemistry, and Physics. In 1898 he was promoted to Assistant Professor of Chemistry. Apparently this marked a shift to focusing on science, but as we will see he never gave up his interest in languages.

In 1901, he entered Johns Hopkins University as a graduate student and in 1904 earned his PhD with a thesis entitled “A Study of the Conductivity of Certain Electrolytes in Water, Methyl and Ethyl Alcohols, and Binary Mixtures of these Solvents.” He was among the first to recognize the significance of viscosity on conductance of electrolytes and his PhD work helped establish this relationship. He briefly returned to Southwestern as a Professor of Chemistry, but in 1905 he joined the University of Arkansas as a Professor of Chemistry and head of the department.

He very quickly published his first paper as faculty member here in the American Chemical Journal (the forerunner of today’s JACS) in 1906 (volume 36, pages 594-599). ‘Ionic Velocity and Ionic Hydration’ proposed that “The velocity of a given ion under a constant fall of potential, is directly proportional to the valency of the ion, the cube root of the ionic (atomic) volume, the dielectric constant of the solvent, and inversely proportional to the viscosity coefficient of the solvent, i.e., for the cation and anion respectively, \( c \eta/n1DV1/3=Kc \) and \( a \eta/n2Dva 1/3=Ka \) where c and a are the respective velocities. The author has tested the law for a number of ions in aqueous and methyl alcohol solutions and found “tolerable” agreement.”

While at the University he taught Inorganic Chemistry, Qualitative Analysis, Quantitative Analysis I and II, Physical Chemistry, Assaying, Agricultural and Food Analysis, Water Analysis, Electrochemistry, History of Chemistry, Chemistry for Teachers, and Quantitative and Qualitative Spectral Analysis and Colorimetry.

In 1907 he married Miss Rubye J. Rothwell of Denver. According to his obituary, “An insatiable intellectual curiosity, a wide diversity of tastes, a discriminating appreciation of music and poetry, a keen sense of humor and a warm heart were among the elements which combined to make Dr. Carroll a charming companion.” This was apparently not just hyperbole as one of his last works was to co-author with Antonio Marinoni (also of the University) French Lyric Poets of the Post-Romantic Period. A true polymath, he appears to be one of the university’s first patent holders, as he and William H. Adams were granted U.S. patent no. 906,383 for a solder for aluminum in 1908. Just to round things out, he also founded the Glee Club, composed music in his spare time, and was active in the Methodist church.

At the time of his death he was still serving as head of the department. He died on February 22, 1916, just forty years old, after suffering from meningitis for some months and is buried in Denton Texas.
The sixth annual University of Arkansas Technology Ventures Inventor Appreciation Banquet was held at the Janelle Y. Hembree Alumni House on Feb. 28. Kim Needy, interim vice provost for research and innovation, presented the awards and Don Bobbitt, University of Arkansas System president, was the guest speaker.

Five inventors were recognized with plaques for their patented inventions. Suresh Kumar Thallapuranam, professor of biochemistry, and David McNabb, associate professor of biological sciences, are co-inventors on two patents. One of them, titled Peptides with Anti-fungal Activity and Methods of using the Peptides, addresses the increasing problem of fungal infections and the decreasing effectiveness of traditional treatments of fungal infections. Kumar and McNabb synthesized peptides based on the study of a naturally occurring antifungal compound, Histatin 5, that occurs in humans. Testing of the peptides shows significant anti-fungal action when used against Candida Albicans, a significant source of sometimes deadly fungal infection.

Their other patent is titled Heparin Affinity Tag and Applications Thereof. This invention finds its use in Recombinant DNA technology, which is extensively used in biotechnology and the pharmaceutical industry. The invention codes into the DNA sequence, along with the sequence of the target protein, an extra bit of DNA, called an affinity tag, that causes the target protein to bind strongly to heparin, a naturally occurring substance. With the target protein attached to the heparin, it can then be easily refined from the rest of the non-target proteins. This process greatly reduces the cost of producing proteins by means of recombinant DNA.

The other inventors recognized that night were Ajay Malshe, Distinguished Professor mechanical engineering, Juan Balda, University Professor of electrical engineering, and Steve Tung, professor of mechanical engineering. Twenty-four inventors were recognized for invention disclosures. Four of them were from the chemistry and biochemistry department. Robert Coridan, assistant professor, Stefan Kilyanek, assistant professor, Z. Ryan Tian, associate professor, and Jingyi Chen, associate professor.

Dr. Tian’s invention was shared with Hulusi Turgut, and is entitled, “Composite Membranes and Applications Thereof.”
Mills Lecture Series Has First Speaker

The inaugural lecture for the new Mills Lecture Series was presented Monday, January 29, 2018 by Dr. Erin Baker, hosted by Dr. Charles Wilkins. Dr. Baker is a bioanalytical chemist with more than 17 years’ experience and >90 publications utilizing ion mobility spectrometry in conjunction with mass spectrometry (IMS-MS) to study environmental and biological systems. In the last 12 years, she has worked primarily on IMS-MS applications in the field of proteomics and more recently she optimized IMS-MS metabolomic, glycomic and lipidomic separations. Her research involves the development and evaluation of high-throughput IMS-MS, SPE-IMS-MS and LC-IMS-MS analyses to quickly study numerous samples in a short time period without losing valuable biological information, as well as assessing the number and quality of features detected with IMS-MS for comparison with existing MS platforms. Dr. Baker is also presently working with the Pacific Northwest National Laboratory (PNNL) Informatics team to design and implement software tools that automatically analyze the complex multidimensional SPE-IMS-MS and LC-IMS-MS data.

Following the lecture, the department faculty and their guests joined Dr. Baker at Emeila’s Mediterranean Kitchen for dinner.

Three Admitted to Candidacy

Curtis Goolsby passed his 7th cume January 26 and was admitted to candidacy. Curtis is from Little Rock, AR and received his BS from the U of A in 2016. His advisor is Mahmoud Moradi. Taylor Snider passed her 7th cume February 9 and was admitted to candidacy. Taylor is from Harrison, AR and received her BS from the UA at Monticello in 2015. Her advisor is Julie Stenken. Justin Reed passed his 7th cume March 2 and was admitted to candidacy. Justin is from Fayetteville, AR and received his BS from the U of A in 2015. Justin’s advisor is Robert Coridan. Congratulations to all three.
Generous Donation to Improve Accessibility and Usage of Instruments for Chemistry Majors

Laboratory improvements have recently been implemented to place analytical chemistry instruments near students, enhancing the learning experience and assuring safety. Discovery Hall 216 was redesigned to house the primary chemical measurement instruments used in the laboratory courses of fundamental analytical chemistry (taken by sophomores and juniors) and instrumental methods of analysis (taken by seniors). The redesigned laboratory space is immediately adjacent to and connected directly with a doorway to the Discovery Hall 215 laboratory, where the sample preparations for these courses take place. This new arrangement allows for an increased frequency of use of the instruments and encourages the development of additional advanced experiments that require the instrumentation. The location will also encourage possible future development of experiments for Majors Freshman Chemistry. The Discovery Hall 216 laboratory renovation also permits safer sample transfer than with the previous upper floor location of those instruments. The laboratory modifications were made possible by a generous $19,000 donation to the Analytical Chemistry fund by Ingrid Fritsch and Charles Wilkins, with the stated objective of improving the overall chemistry experience for both analytical chemistry students & chemistry majors in general.

(Right) Analytical chemistry instruments in their new location, in Discovery Hall 216. On far end of bench on right: two high-performance liquid chromatographs. From left to right along the wall: Fourier Transform infrared spectrometer, fluorimeter, gas chromatograph (GC), and new gas tank corral. (An atomic absorption spectrometer is not shown, but has been installed to the left of the gas tanks since this photo was taken.)

(Left) Students using the GC instrument in the renovated space.

ACS and Biophysical Meeting Photos

Clockwise from top left:
1. Matthew McKay and Fahmida Afrose at the Biophysical meeting.
2. Anh Nguyen, Mamello Mohale, Dr. Colin Heyes, Colette Robinson, and Dustin Baucom at the ACS meeting.
3. Fahmida Afrose with her poster at the Biophysical meeting.
4. Sara Sustich with her poster at the Biophysical meeting.
Alumni Association Announces the Razorback Classics Class of 2018
~From the Newswire, Feb. 23, 2018

Pooja Lukhi, from Conway, Arkansas, a biology and biochemistry double major; Karli Lipinski, from Benton, Arkansas, a chemistry with a focus in biochemistry major; and Gray Orman, from Bryant Arkansas, a biochemistry and pre-med major were all named to the Razorback Classics Class of 2018 by the Arkansas Alumni Association. A total of 11 male and 11 female graduate seniors were selected from the 71 Seniors of Significance recognized in the fall of 2017. They will all be recognized at the Cardinal & White Banquet on May 3 in Boyer Hall of the Janelle Y. Hembree Alumni House. During this dinner and ceremony, each recipient and their mentor will be honored. They will receive a special honor cord to wear at commencement.

Grox Industries One of Two Winners of the National Baylor New Venture Competition

Grox Industries took home the Real Foundations innovation award and $9000 in cash at this competition in Waco, Texas February 24, 2018. Ten of the more than 140 teams who applied to the prestigious competition were invited to compete as finalists. The University of Arkansas was the only institution with two teams in the finals. The other team, medical device company Lapovations LLC took first place and $52,000 in winnings.

Grox Industries has developed a custom, graphene oxide-based coating that improves the energy efficiency of windows, using a technological innovation from the lab of U of A chemistry professor Ryan Tian. The company CEO, Andrew Miles, a graduate of the M.B.A. program at Walton College, was joined at the Baylor competition by Grox chief innovation officer Witness Martin, who is pursuing a Ph.D. in microelectronics-photonics under the mentorship of Dr. Jie Xiao, department of chemistry and biochemistry. Both companies received seed funding from the Delta I-Fund, an Arkansas program designed to help early stage, knowledge-based businesses develop through intensive customer discovery and mentoring.

Witness Martin (l) & Andrew Miles (r)
A research collaboration between the University of Arkansas and Fayetteville High School suggests that students benefited more when using the same type of modeling software used by scientists than through other instructional techniques.

Stephen Burgin, an assistant professor of science education in the College of Education and Health Professions, worked with Mahmoud Moradi, an assistant professor in chemistry in the J. William Fulbright College of Arts and Sciences, to take a free molecular visualization software program that Moradi uses to model large macromolecules into two high school classrooms. The Next Generation Science Standards currently guiding K-12 science instruction in much of the United States list engaging students in the actual methods used by professional scientists as one of the curriculum’s goals, Burgin said. Modeling is an authentic practice used by biochemists in particular.

Burgin described the research in a paper published by the journal Biochemistry and Molecular Biology Education. Co-authors of the paper, along with Moradi, are Michael Kaminski and Linda Stocker, biology teachers at Fayetteville High, and Jennifer Oramous, a doctoral student in science education.

The researchers surveyed students before and after instructional use of the program to investigate any changes in their understanding of the nature of models in science. They found student understanding of four of the five aspects of the nature of models increased significantly. The five aspects are:

- Changing nature of models
- Models as exact replicas
- Models as explanatory tools
- Models as multiple representations
- Use of scientific models.

Understanding of models as exact replicas decreased over the study period but not significantly.

The team also interviewed students and the teachers and found an appreciation for the authentic nature of the program, although the teachers reported some frustration because they didn’t have enough experience with it to use all of its features in the classroom.

“We believe that the evidence at hand indicates that the value of introducing students to authentic molecular modeling tools in high school classrooms outweighs the potential limitations,” according to the article. “The potential for using this program in other high school science classrooms and investigating its impact is substantial especially given the general level of interest in technology that diverse groups of high school students share.”

The researchers encouraged high school biology teachers to work with professional scientists to come up with creative ways to engage students with practices similar to those the scientists regularly use.

Harrison Hale Descendants Visit Department

On Wednesday, March 8, the department was visited by the granddaughter and great-great granddaughter of Harrison Hale. Elinor Clark and Isabella (Bella) Clark flew in to see the building where their grandfather worked and was chair of the department from 1918 to 1945.

Dr. Hale was chair when university president John C. Futrall pushed for a new chemistry building, stating in 1930 the old building was extremely out of date. At that time, chemistry and chemical engineering were combined. The Great Depression left little to no funding for new buildings, but in 1931 the State legislature approved money for a new one. President Franklin Delano Roosevelt’s development of the Public Works Administration (PWA) provided the construction loan for the building of 3 university buildings, including the new chemistry building. The cornerstone was laid in January 1935 and the building was completed in December the same year. 1945 was the first school year that the department of chemical engineering and the department of chemistry were listed as independent units.

The Harrison Hale Lounge in CHEM 220 recognizes and remembers the dedication and contributions of Dr. Hale.
Alumni News

Ryan Bauer (PhD 2017) will be a postdoc in Professor Billy Hudson’s lab at Vanderbilt University, where his new challenge will be in the “collagen registry.” Ryan was a member of the Sakon lab. Professor Hudson is a renowned expert in type IV collagen. He was a recipient of the Protein Society’s 2017 Carl Brandén Award, and the International Society for Matrix Biology’s 2018 Distinguished Investigator Prize. Hudson grew up in a rural community near Harrison, Arkansas. He dropped out of high school at age 16. Henderson State University allowed him to enroll without a high school diploma, and there he earned his BS. Hudson was a REU at UA. He earned his PhD from the University of Iowa and completed his postdoctoral training at Harvard Medical. Every summer, Hudson invites 10 rural high school students from dysfunctional families (many from Arkansas) to be Aspirnaut Research Interns at Vanderbilt where they receive hands-on and mentored laboratory experiences. One success story is of an Aspirnaut alum who was born in prison but is now completing his MD/PhD at Vanderbilt.

Will and Christena Nash (PhD 14) announce the arrival of Ezekiel Norman Nash, born in November of 2017. The family is located in Atlanta, Georgia. Christena was a member of the Fritsch lab.

It’s a Man’s World: Women in the College of Engineering

~From Arkansas Engineer, Oct 31, 2012
Authored by April Robertson

In the course of its history, the University of Arkansas College of Engineering has helped a number of women forge successful careers in engineering and leadership. The initial female graduates were few and far between, and, like every engineering college, the ratio of male to female students has never been equal, but the college’s diversity and atmosphere has come a long way since the first woman entered the college. Dana Jesswein Steele, Betty Yanis, Marilyn Head and Lee Johns Lane, are just a few of the pioneers.

By 1961, six girls were enrolled in the U of A College of Engineering and another six women were alumni. The current dean of the college at the time, Dean Bratigan, wrote an editorial based on a Society of Women Engineers panel, which posed the question, “Can women engineers be effective (productive engineers)?” His opinion placed confidence in women’s abilities as engineers.

Lee Johns Lane (BS in chemistry) was the first woman to graduate from the University of Arkansas with a Ph.D. in engineering. It was the beginning of a successful career in the aerospace industry for her. Over the years, she worked for Dow Chemical Company, Northrop Electronics, General Dynamics corporate and General Dynamics Electronics, Autek Systems and as an instructor for San Diego State and National Universities.

Now retired, Lane continues to split her time between her eight children, three grandchildren and a significant amount of boards and committees for various industry and educational efforts. She was the recipient of the alumni association's alumni of the year award.

To read the complete article, please visit https://bit.ly/2pY0IAQ
The department of chemistry and biochemistry at the University of Arkansas strives for excellence in research, teaching and service in chemistry - the central science. We aspire to positions of leadership regarding the discovery of new scientific knowledge, the training of students, and the economic development of the State of Arkansas. We seek to recruit and retain a diverse group of the best faculty, students and staff to address the challenges of the future through interdisciplinary and multidisciplinary research and education.

MAHSA'S MIRTH
Don’t drink water while studying - Chemistry says that concentration decreases on adding water!

The chemistry and biochemistry library resources can be accessed in the following LibGuides: http://uark.libguides.com/content.php? pid=110953. Please bookmark for future use.
Theses and dissertation resources can be found on the following LibGuide: http://uark.libguides.com/content.php?pid=123035 &sid=1057466.

For more information: Check the Libraries' web site (http://libinfo.uark.edu) for updated information on hours and services. Library hours are also available by dialing 479-575-2557.

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