

NEWSLETTER

Food waste and global security



Dr. Zhengxia Dou, professor of agricultural systems at New Bolton Center

Dr. Zhengxia Dou is professor of agricultural systems in the Department of Clinical Studies, New Bolton Center. Dr. Dou received a B.S. in Chemistry and an M.S. in Soil Sciences and

worked as a lecturer at China Agricultural University, Beijing, before coming to the United States for her Ph.D. in 1989. *continued on page 2*

JORGE ALVAREZ, PhD, JOINS THE DEPARTMENT OF PATHOBIOLOGY

Dr. Jorge Alvarez, assistant professor, has joined the Department of Pathobiology, School of Veterinary Medicine. He was previously affiliated with the hospital research center of the Université de Montréal (CRCHUM). Dr. Alvarez aims to understand the biology of the Central Nervous System (CNS) barriers under homeostatic and inflammatory conditions. These barriers selectively restrict the

molecular and cellular trafficking between the periphery and the CNS, but also serve as a signaling interface that actively regulates exchanges between compartments. His laboratory studies these barriers in the context of diseases like Multiple Sclerosis by experimentally integrating assays making use of human and animal systems.



Jorge I. Alvarez

Student Showcase at Penn Vet

The Phi Zeta Student Research Day is the annual event where Penn Vet students show their academic achievements in basic, clinical and translational research. Penn Vet students compete in oral and poster presentations. Winners are decided on by the keen eyes and ears of faculty judges. *Inspiration Awards* are presented to students who have developed their ideas to produce a project designed to benefit society and the veterinary profession. See more photos about the recent *Phi Zeta Student Research Day* on Page 6.

Dr. Dou—continued from page 1

Her Ph.D. research at Penn State University was focused on nitrogen dynamics in a soil-water-crop rotation system involving corn and alfalfa. In 1994, Dr. Dou joined Penn Vet, first as a research associate and three years later as an assistant professor, and her research program centers on the environmental impact and sustainability of animal farming. Her group has conducted multi-faceted projects consisting of lab-based studies examining the chemical characteristics of manure nutrients, field experiments investigating nutrient transport processes, farm- and watershed-level projects developing integrated nutrient management technologies, and national and international collaborations addressing food security-related issues.

Nitrogen and phosphorus: Nutrients or pollutants?

At the elemental level, nitrogen (N) and phosphorus (P) are among the most foundational nutrients critical for life, particularly for plants and animals involved in primary food production. On animal farms, these nutrients “flow” from the soil to crops (feeds) to animals, with some recycling back to the soil when animal manure is applied to cropland.

However, modern animal operations rely, to a large extent, on feeds grown off-farm to support production needs. This creates an *excess* nutrient problem, leading to accelerated nutrient loss to the environment. In regions with high animal density such as the lower Susquehanna River Basin (encompassing much of Pennsylvania), excessive nutrient loading from the animal farming sector to water bodies such as the Chesapeake Bay is a major factor contributing to water quality decline. Dr. Dou’s group examined the quantitative flow and pathways of N and P on dairy farms. They demonstrated that the critical control point for increasing whole-farm nutrient efficiency resides in herd management. Specifically, optimizing nutrient utilization by balancing nutrients in the animal’s diet enhances animal performance while minimizing nutrient excretion in manure¹. This win-win (for producers and for the environment) strategy, also known as precision feeding, is now widely adopted on farms.

Dr. Dou’s research also helped correct a long-held misperception that P in animal manure was insoluble, and therefore “environmentally benign”. Adapting a P

fractionation procedure previously developed for soils, Dr. Dou’s team found that water-soluble P was the single largest component in manure samples from dairy, swine, and poultry². Notably, water-soluble P is most susceptible to environmental losses. Consequently she obtained funds to test various treatment combinations to “fix” water-soluble P and reduce its potential loss. This research provided the critical support for an integrated research and extension project, which was funded by the USDA and led by Dr. Dou, involving multiple institutions and dozens of dairy farms in New York, Pennsylvania, Maryland, and Virginia.

Continued on page 3



John Toth has worked with Dr. Dou for over 17 years.

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Environmental fate of manure-borne pathogens and anti-biotics

Farm animals naturally harbor a variety of pathogenic bacteria, and are also likely to have received veterinary pharmaceuticals at some point during their life cycle. Therefore, Dr. Dou’s laboratory is interested in questions critical to the health of animals, humans, and the ecosystem at large, including: what happens to the pathogens and drug residues after animals shed them in manure? How long can pathogens survive in the farm environment, e.g. manure storage or

soils where manure is ultimately applied? How do these manure-borne biological and chemical agents affect key soil processes involving the biogeochemical cycling of macro- and/or micro-nutrients? Through collaboration with colleagues within PennVet (Drs. Helen Aceto and Shelley Rankin) and beyond, Dr. Dou’s team found that *Salmonella* Newport and *E. coli* O157:H7 can survive in manure and manured soils for weeks or even months. These multi-drug resistant pathogens are also transported in leaching and runoff water, thereby

presenting considerable risk to the safety of the food supply, aquatic species, farm workers and animals alike³. They further demonstrated that such risks may be mitigated through management strategies such as manure composting. Finally, although previous studies of veterinary pharmaceuticals reported disruption of various soil biological processes, much of the research was conducted using drug concentrations many times greater than the range commonly seen under natural conditions.

Zhengxia Dou continued on page 4

KHORANA SCHOLAR—SHREYA NAHATA will visit Penn Vet

Dr. Narayan Avadhani will host **Shreya Nahata** as a Khorana Scholar in his laboratory this summer. The **Khorana Program for Scholars** is a tripartite arrangement between the Department of Biotechnology (DBT), Government. of India, the Indo-United States Science and Technology Forum (IUSSTF) and WINStep Forward with an

aim to create a dynamic and transformative student exchange program between premier institutions in India and the United States. The program is named in honor of Dr. **Har Gobind Khorana**, who won the Nobel Prize in 1968 for his work at the interface of Chemistry and Biology. As a masters degree student and selected from the top 1.5% of the best students across India, Shreya Nahata will undertake a summer research internship in the Avadhani laboratory. Har

Gobind Khorana was a biochemist who won the 1968 Nobel prize for his research that showed how the order of nucleotides in nucleic acids—which carry the genetic code of the cell—control the cell’s synthesis of proteins.



GOOD GENES!

Uno, shown here, is the great uncle to this year’s Westminster winner. **Miss P** became America’s top dog by winning best in show in a big surprise at the Westminster Kennel Club. At 4, Miss P is a grand-niece of Uno—in 2008, the immensely popular hound barked and bayed his way to becoming the only previous beagle to win at the most prominent U.S. dog show.

Zhengxia Dou continued from page 3

Dr. Dou's team revealed that selected veterinary drugs spiked at *environmentally relevant concentrations* completely blocked soil iron reduction processes and inhibited soil nitrification as well⁴. Dr. Dou and colleague, Dr. Dipti Pitta, are planning to employ metagenomic techniques to further investigate the on-farm distribution patterns of pathogens and their interaction with veterinary drugs to elucidate the potential impact on the ecosystem and public health.

Food waste and global food security

The world population is projected to exceed 9 billion by 2050 and the demand for food will be 50-70% greater than the amount produced today. The ability of the world to meet this demand in a way that is socially equitable, economically viable, and environmentally sound remains a paramount challenge. Wide-ranging discussions have focused on strategies to further enhance food production and supply, largely relying on technological innovation. But the inconvenient truth is that, to date, rapid development and intense anthropogenic activities have exacerbated environmental problems, with widespread water pollution,

biodiversity loss, and soil degradation in particular. Indeed, the overarching challenge is to increase food availability using fewer resources, while minimizing the potential environmental impact. Spurred by recent reports that one third of food produced for human consumption is wasted, Dr. Dou has taken a keen interest in addressing food waste issues. Working closely with PennVet colleagues (Drs. J Ferguson, D Galligan, and A Kelly) as well as other Penn schools, she organized *The Last Food Mile Conferences* in December 2014, a first-of-its-kind event addressing food loss and waste in the U.S. supply chain. Dr. Dou has a strong belief in the waste-less-to-feed-more approach, as it is socially, economically, morally, and environmentally desirable. She is leading the efforts on multiple fronts in pursuing this line of work. Examples of work-in-progress include: (i) quantification of resource use and environmental cost (land, water, energy, nutrients) associated with wasted food by U.S. consumers, (ii) a comprehensive review and analysis of food wastage across the U.S. supply chain and the opportunities to reduce it, per invitation of the journal *Global Food Security*, (iii) a book

project stemming from The Last Food Mile Conference, and (iv) initiatives for interdisciplinary and multi-nation collaborations including colleagues in China and the United Kingdom. Dr. Dou's goal is to utilize this multi-faceted approach, which integrates research, education, and outreach, to identify novel and responsible ways to help alleviate the growing problem of world hunger.

Support for Dr. Dou's research comes from USDA, EPA, the National Fish and Wildlife Foundation, Pennsylvania Animal Health Commission, Pennsylvania Department of Agriculture, and the University of Pennsylvania.

References

1. Dou, Z., J.D. Ferguson, J. Fiorini, J.D. Toth, L.E. Chase, K.F. Knowlton, R.A. Kohn, J.T. Sims, and Z. Wu. Phosphorus feeding levels and critical control points on dairy farms. *J. Dairy Sci.* 86:3787-3795, 2003.
2. Dou, Z., J.D. Toth, D.T. Galligan, C.F. Ramberg, Jr., and J.D. Ferguson. Laboratory procedures for characterizing manure phosphorus. *J. Environ. Qual.* 29: 508-514, 2000.
3. Toth, J.D., S. Rankin, H. Aceto, Z. Dou. Survival characteristics of *Salmonella enterica* serovar Newport in the dairy farm environment. *J. Dairy Sci.* Vol. 94:5238-5246. 2011.
4. Toth, J.D., Y. Feng, Z. Dou. Veterinary Antibiotics at Environmentally Relevant Concentrations Inhibit Soil Iron Reduction and Nitrification. *Soil Biol Biochem* Vol. 43:2470-2472, 2011.
5. <http://www.vet.upenn.edu/last-food-mile-conference>





NIH News.....

NIH requires the new biosketch format ([NOT-OD-15-032](#)) for all competing and non-competing applications submitted for due dates on or after May 25, 2015

The 1st Penn Fibrosis Symposium

April 17, 2015
Penn Vet Hill Pavilion

Register online:

[The First Penn Fibrosis Symposium](http://TheFirstPennFibrosisSymposium.somapps.med.upenn.edu)
somapps.med.upenn.edu

Penn Vet Publications



Charles Vite
Intracisternal cyclodextrin prevents cerebellar dysfunction and Purkinje cell death in feline Niemann-Pick type C1 disease. (2015) **Vite CH**, Bagel JH, Swain GP, Prociuk M, Sikora TU, Stein

VM, O'Donnell P, Ruane T, Ward S, Crooks A, Li S, **Mauldin E**, Stellar S, De Meulder M, Kao ML, Ory DS, Davidson C, Vanier MT, Walkley SU. *Sci Transl Med.* 7(276):276ra26. Link to Press Release: [Penn News | Penn Vet Researchers Identify Effective Treatment for Niemann Pick Type C](#)

Jeremy Wang—Polycomb Protein SCML2 Associates with USP7 and Counteracts Histone H2A Ubiquitination in the XY Chromatin during Male Meiosis (2015). Luo M, Zhou J, Leu NA, Abreu CM, Wang J, Anguera MC, de Rooij DG, Jasin M, and **Wang PJ**. *PLoS Genetics*.11(1):e1004954.



The RNA helicase MOV10L1 binds piRNA precursors to initiate piRNA processing. (2015) Vourekas A, Zheng K, Fu Q, Maragkakis M, Alexiou P, Ma J, Pillai RS,

Mourelatos Z and **Wang PJ**. *Gene Dev.* 29(6):617-629.



Dan Morris—The shared microbiota of humans and companion animals as evaluated from *Staphylococcus* carriage sites. (2015) Mistic AM, Davis MF, Tyldsley AS, Hodgkinson BP, Tolomeo P, Hu B,

Nachamkin I, Lautenbach E, **Morris, DO** & Grice E. *Microbiome* (Jan 23) 3:2 doi: 10.1186/s40168-014-0052-7. eCollection.

STUDENTS MEET RESEARCH FACULTY

In January, SCAVMA hosted the inaugural "Meet-A-Mentor" Research Dinner, that brought together students and research faculty for good food and conversation. Thirty students from V'17 & V'18 met with Penn Vet faculty to learn about their research and discuss possible research projects. The process of finding a research mentor can be daunting and this event allowed students and faculty to meet in an informal environment, discuss broad topics in research, and make connections for student projects. SCAVMA thanked the faculty for their participation and look forward to hosting this event again next year! Those researchers who participated were: Narayan Avadhani, Bruce Freedman, Meggan Hain, Kristina Horback, Rachael Kreisler, Cindy Otto, Nicola Mason, Michael May, Jamie Monslow, Thomas Schaar, Dieter Schifferli and Carlo Siracusa. The students thanked **Michael Atchison** for helping to organize the event and present funding opportunities to students."



Immune reaction to malaria

Michael Povelones, assistant professor in the Department of Pathobiology studies the immune system of a mosquito. Just like a person, a mosquito's immune system fights off infection so it doesn't get sick. The research indicates that the insect's immune system proteins spring into action after a mosquito feeds on blood—an act that is

critical to its survival and reproduction, but also potentially risky because of the pathogens that blood might contain. "This appears to be a new mechanism by which the mosquito is anticipating a parasite infection," says Dr. Povelones.

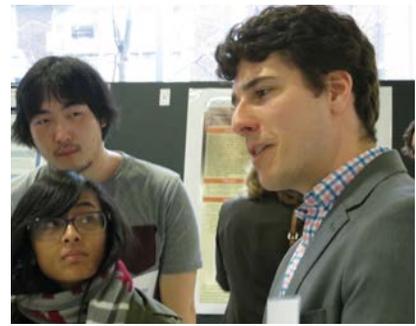
Link to Katherine Unger Baillie's press release:

[Blood-sucking triggers immune reaction to malaria in mosquitoes | Penn Current](#)



Phi Zeta STUDENT RESEARCH DAY 2015

Students, faculty and guests convened for the annual Phi Zeta Student Research Day. Oral presentations are given by the students whose abstracts were selected by faculty judges. Those who did not give talks presented their work in poster format. Talks and posters were judged competitively by faculty and alumni judges. The winners were: 1st place in the dual degree presenters, **Jonathan Madara**; 1st place in the VMD presenters, **Beatriz Blanco**; 2nd place dual degree, **Bailey Baumann**, 2nd place VMD, **Ashley Power**; and 3rd place dual degree, **Ian Penkala**, 3rd place VMD, **Alexandra Crooks**. 1st place in the poster competition was awarded to **Sherrie Xie**, 2nd place to **Abigail Shearin**, and 3rd place to **Sarah Colmer**. In addition to the oral and poster presentations, Inspiration Awards were given to: **Meghana Pendurthi**, **Ashley Cherry**, **Jonathan Madara**, **Christiana Fischer**, and **Katherine Very**.



Michael Levenson describes his poster



Sarah Colmer describes her project



Dr. Peter Dodson, professor and authority on *heratopsians* (horned dinosaurs) was interviewed by Dean Joan Hendricks. Dr. Dodson gave an entertaining and informative overview of his career in paleontology and at Penn Vet.



The Class of 66 Keynote Lecture was given by Dr. John Clifford, Chief Veterinary Officer for the USDA.



Jonathan Madara won in both the oral presentation category and received an Inspiration Award



Kristen Conniff talks about her research project



Penn Vet Faculty & Alumni judge the posters



Raisa Glabman describing her poster to judge Dr. Helen Aceto at Student Research Day March 26, 2015

RECENT AWARDS

(Direct Costs)

Thomas Schaer

NIH/ subcontract from Thomas Jefferson University, Creating an infection-free introsseus transcuteaneous amputation prothesis
1/1/2014-1/31/2016 \$100,055

Billy Smith

Commonwealth of PA
Using low street handling techniques and acclimation to decrease stress during transition and early lactation in dairy heifers
1/1/2015-6/30/2015 \$12,020

Zhiguo Wu

Commonwealth of PA
Management of phosphorus nutrition to reduce dairy cow milk fever
1/1/2015-6/30/2015 \$35,000

Narayan Avadhani

NIH/NIAAA
CYP2E1 Mediated Mitochondrial injury and Cell Damage in Alcohol Liver Disease
R01-AA022986
02/05/15- 12/31/19 \$1,953,811

Narayan Avadhani

NIH/NIGM
Role of Mitochondria-Targeted CYP2D6 in Chemical Toxicity
2/15/15-12/31/19 \$1,077,300

Frank Luca

URF- Fall 2014:
A Zebrafish model for investigation Ndr Kinase-dependent retina development
3/1/15 -2/29/16 \$50,000

Igor Brodsky

NIH R21 AI117365
Harnessing inflammasome activation to enhance efficacy of Salmonella vaccines
1/1/15-12/31/16 \$280,725

James Lok

NIH/ AI
Mechanisms and Treatment of Chronic, Latent Human Strongyloidiasis
3/16/15-2/28/18 \$1,158,891

Gus Aguirre

NIH/NEI
Models for Therapy of Hereditary Retinal Degeneration
1/1/15-11/30/19 \$3,421,800

JD Foster

Immunicom
A multi center, open label study to evaluate safety and effectiveness of Immunicom Apheresis Immunoabsorption Affinity column in combination with Terumo BCT Spectra Optia Apheresis system for treatment of malignant melanoma and other naturally occurring malignancies in the dog
1/5/15-12/31/15 \$82,323

Michelle Giuffrida

Merial Limited
Evaluation of the efficacy and safety of feline interleukin-2 immunomodulator (ALVAC® IL-2) as an adjunct treatment for feline fibrosarcoma following surgical excision of the tumor
12/1/14-12/31/17 \$64,000

Mark Rondeau

Royal Canin
The role of the microbiome in resolution of canine chronic enteropathy
12/15/14-6/30/16 \$39,999



Update—Dr. Nicola Mason's innovative approach to treating dogs with osteosarcoma involves

immunotherapy in which the patient's own immune system is triggered to target and kill tumor cells. Having started the trial in 2012, Mason is starting to see the first few dogs originally diagnosed in May and June of 2012 reach their **3 year** "ampiversary"! Furthermore, these dogs have no evidence of metastatic disease. It is now hoped that these positive results will be echoed in human trials evaluating the same listeria-based immunotherapy approach that will start in 2015.



Penn Vet faculty member, Dr. **Ron Harty** presented his work at the **7th International Symposium on Filoviruses (Ebola: West Africa & Recent**

Developments (March 2015) in Washington DC. Dr. Harty presented work on "Host-oriented inhibitors of *Filovirus* budding" and "Entry and exit of Ebola Virus in canine and feline cells".

Penn Vet Publications

Permanent uncoupling of male-specific CYP2C11 transcription/translation by perinatal glutamate (2015) Banerjee S, Das RK, Giffear KA, and **Shapiro BH**, *Toxicol Appl Pharm* 284(1) 79-91.

Exclusion of the unfolded protein response in light-induced retinal degeneration in the canine T4R RHO model of autosomal dominant retinitis pigmentosa (2015) Marsili S, Genini S, Sudharsan R, Gingrich J, **Aguirre GD**, and **Beltran WA** *PLoS One* 10(2) e0115723



Transformation of the intestinal epithelium by the MSI2 RNA-binding protein (2015) Wang S, Li N, Yousefi M, Nakauka-Ddamba A, Li F, Parada K, Rao S, Minuesa G, Katz Y, Gregory BD, Kharas MG, Yu Z, & **Lengner CJ** *Nature Communications* 6:6517



Immunity to *Toxoplasma gondii* - into the 21st century (2015) Coombes JL and **Hunter CA** *Parasite Immunol* 37(3):105-107.



Leptin and insulin act on POMC neurons to promote the browning of white fat (2015) Dodd GT, Decherf S, Loh K, Simonds SE, Wiede F, Balland E, Merry TL, Munzberg H, Zhang ZY, Kahn BB, Neel BG, **Bence KK**, Andrews ZB, Cowley MA, & Tiganis T. *Cell*: 160(1-2): 88-104.

Center for Host-Microbial Interactions tests new sequencer

The Center for Host-Microbial Interactions (CHMI) has been selected to test new portable



sequencing technology developed by Oxford Nanopore. The MinION™ Access Programme (MAP) allows scientists to develop single-molecule, real-time sensing applications such as DNA sequencing using a proprietary device about the size of a USB stick. The MAP encourages and enables open development. ‘Hacking’ of sample preparation,

run conditions and analysis software is both enabled and encouraged. Oxford Nanopore's objective is to enable scientists to fit the platform technology to their applications rather than force scientists to fit their diverse applications to a prescriptive platform. Drs. **Dan Beiting and Dieter Schifferli**, Department of Pathobiology, will sequence the genome from different strains of *Salmonella* isolated from veterinary species. If successful, the portable nature of this device and its ability to produce sequence data in real-time, could allow veterinarians to monitor disease outbreaks in the field by looking the genetic 'fingerprint' of a pathogen. If successful, this technology may be deployed in the field, allowing veterinarians to monitor disease outbreaks.

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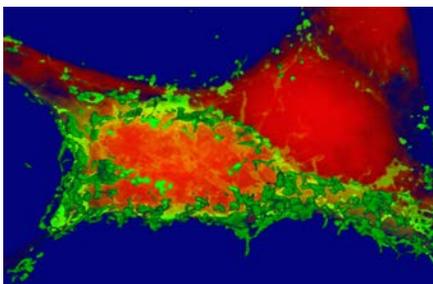
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HEK293T cell expressing GFP-tagged Ebola VP40 protein and stained with HCS CellMask Deep Red. Image courtesy of Jonathan Madara, Gordon Ruthel, Ron Hartly, & Bruce Freedman. Penn Vet Imaging Core (PVIC)—see the new PVIC webpage: [imaging-core](#): link:

[Penn Vet | Imaging Core](#)

TO: