One Health initiative

extension
ALABAMA A&M & AUBURN UNIVERSITIES

SerPIE One Health Conference

on Pharmaceuticals and Personal Care Products

CONFERENCE PROCEEDINGS

Utilizing a One Health Approach to Achieve Zero Pharmaceutical Waste

Huntsville AL, June 19–20, 2016

Utilizing a One Health Approach to Achieve Zero Pharmaceutical Waste

► SerPIE One Health Conference on Pharmaceutical and Personal Care Products.
June 19-20, 2016 – Embassy Suites Hotel, Huntsville, AL.

About the Conference

The One Health Conference is an interdisciplinary initiative that brings experts together in the areas of human, animal, and environmental health to discuss current research and Extension activities being undertaken to minimize societal and environmental impacts of pharmaceuticals and personal care products.

About SerPIE

SerPIE (Synergistic Efforts to Reduce Pharmaceuticals in the Environment) is an Alabama Cooperative Extension System initiative. The overall goal of SerPIE is to provide programming that addresses emerging safety issues in environmental, human, and animal health science as it relates to pharmaceuticals in the environment.

Figure 1. Prescription drug bottles. Stock photo: Smartstock

Speakers (in order of appearance)

Dr. Samuel Chan, Oregon State University, Corvallis, OR
Dr. Vivian Fuhrman, Product Stewardship Institute, Philadelphia, PA
Dr. Lawrence Robey, Madison County Public Health Department, Huntsville, AL
Special Agent Treva Whitfield, United States Drug Enforcement Agency (DEA), New Orleans, LA
Vernon Crockett, Alabama Department of Environmental Management, Montgomery, AL
Margretta Morris, Covanta Energy, Morristown, NJ
Sofia Vielma Delano, Purdue University, West Lafayette, IN
Dr. Patricia Darbishire, Purdue University, West Lafayette, IN
Dr. Susan Glassmeyer, United States Environmental Protection Agency (EPA), Washington, DC
Sara Zach, Illinois-Indiana Sea Grant, Chicago, IL
Paul Ritter, Pontiac Township High School, Pontiac, IL
Linda Tucker Serniak, Oregon State University, Corvallis, OR
Dr. Warren Hess, American Veterinary Medical Association, Schaumburg, IL
Dr. Joe Cobb, Colbert Animal Clinic, Tuscumbia, AL
Nancy Holm, Illinois Sustainable Technology Center, Urbana-Champaign, IL
Denise Heubach, Alabama Cooperative Extension System, Alabama A&M University, Normal, AL
Ahmed Abdel-Moneim, Purdue University, West Lafayette, IN
Ravneet Kaur, Tennessee State University, Nashville, TN
Dr. Paul Okweye, Alabama A&M University, Normal, AL
Dr. Odemari Mbuya, Florida A&M University, Tallahassee, FL
Dr. Asmare Atalay, Virginia State University, Virginia State University, VA
Dr. Xiongwen Chen, Alabama A&M University, Normal, AL

Program

Dr. Vivian Fuhrman, *Associate for Policy & Programs*, Product Stewardship Institute, Inc.
Dr. Virginia Caples, *1890 Administrator*, Alabama Cooperative Extension System
Dr. Celvia Stovall, *Associate Director*, Alabama Cooperative Extension System
Sarah Zach, *Pollution Prevention Specialist*, Illinois-Indiana Sea Grant, Chicago, IL

Exhibitors

Alabama A&M University
College of Agricultural, Life & Natural Sciences
Alabama Cooperative Extension System
Generation Rx
Urban Affairs & New Nontraditional Programs
4-H Health Rocks!®
SerPie
Water Wheels Outdoors Conservation Laboratory
Bradford Health Services
Cahaba Riverkeepers
Covanta Energy
Environmental Waste Services Alabama, Inc.
Illinois-Indiana Sea Grant
Partnership for a Drug-free America

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United States Department of Agriculture (USDA)
Illinois-Indiana Sea Grant
Kentucky State University
Tennessee State University
University of Benin, Nigeria
University of Illinois Extension
Covanta Ltd.

Conference Planning Committee Coordinators

Dr. Karnita Garner, *Environmental Specialist,* Alabama Cooperative Extension System
Dr. Paul Okweye, *Associate Professor*, Alabama A&M University
Laura Kammin, *Outreach Program Leader*, Illinois-Indiana Sea Grant
Sarah Zach, *Pollution Prevention Specialist*, Illinois-Indiana Sea Grant

Members

Dr. Asmare Atalay, *Extension Specialist*, Virginia State University
Dr. Kamala Bhat, *Associate Professor,* Alabama A&M University
Dr. Maria Leite-Browning, *Extension Animal Scientist*, Alabama Cooperative Extension System
Dr. Dorothy Brandon, *Consumer Science/Personal Financial Management Specialist*, Alabama Cooperative Extension System
Phillip Carter, *Urban Regional Extension Agent*, Alabama Cooperative Extension System
Edna Coleman, *Retired Youth & Volunteerism Specialist*, Alabama Cooperative Extension System
Attorney Kevin Crenshaw, *Consultant*, Alabama Cooperative Extension System
Chanda Mills Crutcher, *Founder*, American Senior Assistance Programs
Jean Hall Dwyer, *Communications Specialist*, Alabama Cooperative Extension System
Jackie Collier, *Administrative Assistant,* Alabama Cooperative Extension System
Dr. Sam Dennis, *Professor,* Tennessee State University
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Dr. Vivian Fuhrman, *Associate for Policy & Programs*, Product Stewardship Institute, Inc.
Marcus Garner, *Urban Regional Extension Agent,* Alabama Cooperative Extension System
Donna Gilbert, *Administrative Assistant,* Alabama Cooperative Extension System
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Roosevelt Robinson, *Urban Regional Extension Agent*, Alabama Cooperative Extension System
Debra Scruggs, *Administrative Assistant* , Alabama Cooperative Extension System
Allyson Shabel, *Urban Regional Extension Agent,* Alabama Cooperative Extension System
Robert Spencer, *Animal Science Specialist,* Alabama Cooperative Extension System
Dr. Wubishet Tadesse, *Professor,* Alabama A&M University
Dr. Teferi Tsegaye, *Professor*, Kentucky State University
Dr. Tamara Warren, *Nutrition Specialist,* Alabama Cooperative Extension System
Wendi Williams, *Communications Specialist,* Alabama Cooperative Extension System

Figure 2. Personal Care Products. Stock image by: JackF.

Message from the Keynote Speaker

"Utilizing a One Health Approach to Achieve Zero Pharmaceutical Waste"

Framing a Collaborative Approach to Addressing Emerging Concerns from Pharmaceuticals and Personal Care Products in the Environment

Samuel S. Chan, PhD; Laura Kammin; Sarah Zack; and Karnita Golson-Garner, PhD

While pharmaceuticals and personal care products (PPCPs) help people and animals live healthier lives, their use comes with unforeseen consequences when they enter waters and watersheds through excretion and disposal. Studies in North America and abroad have identified PPCPs in rivers, lakes, coastal waters, groundwater, sewage wastewater, landfill leachate, soils, air, and plant and animal tissues. The effects of PPCPs are different from conventional pollutants in that pharmaceuticals are purposefully designed for bioactivity and therapy at low concentrations. There is growing scientific evidence that even low concentrations of PPCPs currently detected in United States waterways can have unintended adverse effects on aquatic organisms and the ecosystems in which they reside.

The objectives of this transdisciplinary national conference on PPCPs are to strengthen connections and encourage future collaboration between environmental scientists, physicians, veterinarians, educators, and stakeholders (including consumers) to improve aspects of health for humans, animals and the environment as they relate to PPCPs. Researchers studying PPCPs often express the need to engage the "ecosystem" of disciplines or "one health approach " to working on the issues and addressing the importance of the social dimensions to pollution prevention. This conference examines the roles and trends in the science, clinical practice, education, outreach, social, and policy dimensions to pollution prevention for PPCPs.

Much of the current work on PPCPs in the environment focuses on their source, monitoring, fate, treatment and the possible ecosystem impacts of these chemicals of emerging concern (CECs). Some of the PPCP contaminants are known endocrine disruptors, possible human carcinogens, or contribute to antibiotic resistance. PPCPs were recently detected for the first time in tissues of migratory juvenile Chinook salmon and in oysters in the Pacific. Most of the chemicals detected are not monitored or regulated in wastewater, and there is little or no established science on the environmental toxicity for the vast majority of the compounds detected. Though the levels are probably too low in the water to be active in humans and fish, one of the reasons that wastewater pollutants such as PPCPs are considered CECs is because so little is known about them. Wastewater treatment technologies can remove some pharmaceuticals from wastewater, but these technologies are expensive to build and operate, and they often lag the development of new classes of drugs.

Survey-based studies in California, Europe, and more recently of pet owners in North America, indicate that between 25-50% of all prescribed and over-the-counter medications purchased by consumers may go unused. Although only 10-30% of this unused portion is reportedly flushed, the majority are stored and ultimately disposed in the garbage. Event-driven drug take-back programs, while helpful, are a limited solution. This presents a growing potential future risk to water resources, as these unused medicines accumulate with existing consumers and the demand for pharmaceuticals is increasing with an aging demographic.

Working with consumers and health care professionals about more effective PPCP use and methods to generate less PPCP waste, in part through proper disposal of pharmaceuticals, are important strategies for reducing PPCP flows into watersheds. However, current practices mostly emphasize ecologically friendly ways to dispose of unwanted PPCPs such as take back programs, not flushing, and improving treatment technologies versus source reduction. From a PPCP product lifecycle perspective, current programs emphasize the downstream "discharge and disposal" stage, without fully understanding the upstream production and prescription stage, driving "uses" that create these PPCP flows. Leadership is needed for product stewardship and there are questions regarding

who is financially responsible for medicine take-back programs and outreach.

Social analysis of the consumers and health care professionals that contribute to PPCP flows may help us to identify additional and/or better points to control or reduce the discharge and disposal of pharmaceuticals. Integrating the needs and contributions of health care professionals, environmental managers and scientists, social scientists and educators can enhance research and help prioritize PPCP management and the protection of water resources-based on human decision points and triggers to behaviors. With a focus on solutions that emerge through a transdisciplinary understanding of the issue, we can achieve broader impacts in addressing the emerging issues of unwanted PPCPs in the environment by examining barriers and exploring new solutions to developing state and nationwide PPCP pollution prevention strategies.

Figure 3. Scientist taking water sample. Stock image by: Irina Vodneva.

Oral Presentation Abstracts

Framing a Collaborative Approach to Addressing Emerging Concerns from Pharmaceuticals and Personal Care Products in the Environment

Author: Samuel S. Chan, PhD, *National Sea Grant Program*, Oregon State University

Co-Authors: Laura Kammin, Sarah Zack, and Karnita Golson-Garner

While pharmaceuticals and personal care products (PPCPs) help people and animals live healthier lives, their use comes with unforeseen consequences when they enter waters and watersheds through excretion and disposal. Studies in North America and abroad have identified PPCPs in rivers, lakes, coastal waters, groundwater, sewage wastewater, landfill leachate, soils, air, and plant and animal tissue. The effects of PPCPs are different from conventional pollutants in that pharmaceuticals are purposefully designed for bioactivity and therapy at low concentrations. There is growing scientific evidence that even the low concentrations of PPCPs currently detected in United States waterways can have unintended adverse effects on aquatic organisms and the ecosystems in which they reside. With a focus on solutions that emerge through a transdisciplinary understanding of the issue, broader impacts in addressing the emerging issues of unwanted PPCPs in the environment by examining barriers and exploring new solutions to developing state & nationwide PPCP pollution prevention strategies can be achieved.

Drug Take-Back Programs: Past, Present, and Future

Author: Vivian Fuhrman, PhD, *Associate for Policy and Programs*, Product Stewardship Institute

When unwanted and expired pharmaceuticals are stored in the home, they become susceptible to misuse and abuse. However, ample research demonstrates that improper disposal of these drugs, such as trash disposal or flushing them down a drain, poses serious environmental risks. Measurable concentrations of pharmaceuticals have been detected in waterways across the United States, threatening aquatic ecosystems and posing potential risks to humans. Manufacturer-funded pharmaceutical collection programs present the best option for safe and convenient disposal of leftover medications, and a sustainable solution to the many problems they otherwise pose. With seven local laws on the West Coast mandating drug take-back programs, one state provision passed in Massachusetts, and legislation being prepared at the federal level, producer-funded collection is gaining support. This session will explore the path taken to develop voluntary and mandatory drug take-back programs currently in operation, including the 2015 United States Supreme Court's decision to deny the pharmaceutical industry's petition against the Alameda County Safe Drug Disposal Ordinance, paving the way for other municipalities and states around the country to pursue similar take-back legislation. The session will detail the role government, pharmacies, law enforcement, pharmaceutical companies, and other key stakeholders can play in initiating and implementing effective programs.

Figure 4. Woman taking pills. Stock image by spukkato.

Prescription Drug Abuse: A Major Public Health Problem

Author: Lawrence Robey, MD, Alabama Department of Public Health

For the first time in 30 years deaths due to drug poisonings have exceeded the number of deaths due to motor vehicles. Although physicians prescribe more and more drugs to patients, patients do little to secure them away from the hands of small children, teens, or other potential drug abusers. What is not abused ends up being thrown or flushed away to public landfills or local waterways where they become potential hazards to the environment and wildlife. Find out how you can help to prevent this public health crisis.

The Prescription Opioids Epidemic & DEA's National Prescription Drug Take Back Program

Author: Treva Whitfield, *Special Agent*, United States Drug Enforcement Administration

Thousands of Americans die every year from prescription pain medications, many of which come from the family medicine cabinet. In response, the United States Drug Enforcement Administration (DEA) started the National Prescription Drug Take-back Program in 2010 to provide the general public with a safe, convenient, responsible, and environmentally sound way to dispose of unused, unwanted, or expired prescription drugs. This presentation will highlight the DEA Take Back Program, supported with national and local statistics, as well as inform the audience regarding the current prescription opioids and heroin epidemic in the United States.

Regulation of Hazardous Pharmaceutical Wastes

Author: Vernon Crockett, *Chief, Industrial Hazardous Waste Branch*, Alabama Department of Environmental Management

This presentation will provide an overview of concerns from a state regulatory perspective about waste pharmaceuticals and proposed Environmental Protection Agency regulations that can be used to address them.

Prescription for Safety

Author: Margretta Morris, Vice President, *Materials Management and Community Affairs*, Covanta

Prescription drug abuse now accounts for more deaths than automobile accidents. That indicates a staggering new societal problem that requires a variety of solutions. This presentation will address one such solution, being the collection and destruction of unwanted, outdated, prescription medications. Covanta's highly successful Prescription for Safety (Rx4Safety) program works in conjunction with law enforcement at the local, state, and federal levels, providing free and environmentally safe disposal for residentially collected pharmaceuticals. The presentation will include an overview of the energy-from-waste technology as well as the company's motivation for offering this environmentally important service to all United States communities, regardless of size or location. Participants will learn why it's important to manage not only pharmaceuticals, but personal care products as well in the most safe and secure fashion, rather than just throwing or flushing them away.

Willingness to pay for a Medicine Disposal Program in the Midwest: A Double Hurdle Approach

Author: Sofia Vielma Delano, *Graduate Student*, Purdue University

Co-Author: Kwamena Quagrainie

There have been increasing concerns about the environmental impact of pharmaceutical accumulations in surface water over the last two decades. Several states in the nation have implemented medicine take-back programs to help mitigate problems associated with unused pharmaceuticals in households. States bordering the Great Lakes have particularly been concerned about the impact of accumulations of pharmaceuticals. This study assessed the value of a pharmaceutical collection program based on the willingness to pay (WTP) per prescription as well as WTP per visit of current and potential consumers of the program. We found that 60% of the population is willing to participate in a collection program, while 40% are willing to pay to participate in the program. The estimated mean WTP from the Double Hurdle Model is $1.25 per prescription and $2.33 per visit. The mean WTP for those willing to participate (including willingness to pay zero) is $0.53 per prescription and $1.03 per visit. Total annual benefits for such programs are estimated to be $21.6 million when considering WTP per prescription, and $20.7 million for a single

drop-off per year when considering WTP per visit. This information will help to better inform program providers, researchers, policymakers, and other interested parties.

Engaging Students in Unwanted Medication Disposal Research

Author: Patricia Darbishire, PhD, *Clinical Associate Professor and Director*, Pharmacy Practice, Purdue University

This presentation describes student involvement in medication disposal research to determine what types of medications commonly go unused and why, as well as medication disposal practices and public opinion. Student pharmacists and a faculty mentor hosted 15 community medication take-back events in conjunction with community partners. Prescription, over-the-counter medications, and personal care products were collected and placed into 1 of 10 primary drug classifications, and a survey was administered to participants. Students recorded the drug name, drug class, controlled status, and expiration date of medications collected. Educational brochures on safe disposal methods were distributed to participants. Four hundred and seventy-eight surveys were collected and 4,993 medications and personal care products were identified and analyzed. The top three reasons for bringing medications to collection events included: medication expired (70.6%), medication changed (42.8%), and medical condition resolved (33.5%). The average number of medications returned per person was 10, and the average number of years the product was expired was 4.8. Fifty-eight percent of medications returned were prescribed, 40% were purchased over-the-counter, and 2% were veterinary medications. The top 3 drug categories collected were analgesics (26%), cough and cold products (16%), and anti-infectives (11%). The most commonly returned medication was hydrocodone/acetaminophen.

Overview of US Environmental Protection Agency Research on Pharmaceuticals and other Contaminants of Emerging Concern

Author: Susan Glassmeyer, PhD, *Research Chemist*, United States Environmental Protection Agency

Pharmaceuticals and other contaminants of emerging concern are present throughout the water cycle due to their use and/or disposal. The United States Environmental Protection Agency and its sister federal agencies have been conducting research examining the occurrence, fate, and transport of these chemicals. This presentation will highlight some of the research examining pharmaceuticals in surface water, wastewater and drinking water, as well as discuss ways to mitigate their occurrence in the environment.

Figure 5. Enducation Infographic Example. Stock image by mheim3011.

Building Partnerships and Having Impact: Reducing PPCP Contamination in the Great Lakes through Research, Education, and Outreach

Author: Sarah Zack, *Pollution Prevention Extension Specialist*, Illinois-Indiana Sea Grant

While PPCPs improve the lives of people, livestock, and pets, their use also comes with unintended consequences. Over the past decade, the Illinois-Indiana Sea Grant (IISG) has been working to educate targeted audiences about the sources, fate, and impacts of PPCPs on human, animal, and environmental health. Our goal is to reduce accidental poisonings, curb prescription drug abuse, protect wildlife and the environment, and improve water quality. IISG takes a multi-pronged approach to reducing the load of PPCPs reaching Lake Michigan and other waterways within the Great Lakes Basin through: funding research, developing education and outreach programs, communicating through social media, providing communities with guidance on setting up medicine take-back programs, and building partnerships. This presentation will describe some of the recent research funded by IISG; outline curricula and outreach resources available; detail medicine take-back efforts supported by IISG in Illinois, Indiana, Wisconsin, and Michigan; and highlight outreach efforts that have come to fruition through collaboration with the American Veterinary Medical Association, the Prescription Pill and Drug Disposal (P2D2) Program, the Sea Grant National PPCP Working Group, the United States Environmental Protection Agency, and other partnerships.

From Saving the Water Supply to Saving Lives: The International Prescription Pill and Drug Disposal Program (P2D2) - Eco-conscious Curriculum to Inspire Students

Author: Paul Ritter, Director/Teacher, *The International Prescription Pill and Drug Disposal Program*, Pontiac Township High School, Pontiac, IL

Communities, educators, and students alike will discover the reinvigorating effects of civic activism as they engage conservation through curriculum. Using our environmentally-conscious curriculum and/or use pre-developed lesson plans researched from publications such as The Medicine Chest: A Collection of Safe Disposal Curriculum Activities and Service-learning Resources published by the University of Illinois and funded by the Illinois-Indiana Sea Grant, there is hope that educators can reclaim joy in teaching, learning, and research as they create and modify content designed to motivate students about the environment and the very water they drink, as well as the inhabitants of global waterways. Students embracing the curriculum will step far beyond the confines of the classroom as their own skills are flexed in an attempt to capture other hearts and minds, inspiring a zeal for saving the water supply from improper medication disposal.

What role might pet owners have on unused pharmaceutical and personal care products entering the aquatic environment?

Author: Linda Tucker Serniak, *Graduate Student*, Oregon State University

Co-Authors: Kayla-Maria Martin, Samuel Chan, Tania Siemens, Danielle Goodrich, Noelle Moen, and Jennifer Lam)

There is little understanding on how PPCPs are reaching our waterways, and information examining specifically the impacts of PPCPs on our rivers, streams, estuaries, groundwater, oceans, and drinking water. Oregon State University and the Oregon Sea Grant College Program launched a national survey aimed to learn the decisions on the use, storage, and disposal of human and pet PPCPs. Findings quantify the current disposal practices of both human and pet PPCPs as major pathways into the environment. The majority of survey takers agreed they value clean water and air, and the impacts of PPCPs on the aquatic environment were cited as a major concern for the public. Respondents cited the lack of PPCP stewardship information dictated their current practices. If provided proper information, many are willing to share information on proper use and disposal. Findings are intended for pet health professionals, public conservation agencies, organizations and educators in guiding outreach options that enable safer use, storage, and disposal practices. Safe and accessible stewardship and disposal practices for PPCPs will help to reduce the risks from misuse, accidental poisonings, abundance in the environment, and unintended impacts on aquatic life and water quality.

The Role of Veterinarians in Proper Pharmaceutical Disposal

Author: Warren Hess, DVM, *Assistant Director,* American Veterinary Medical Association

Co-Author: American Veterinary Medical Association

While prescription and over-the-counter medications can help people and animals when used appropriately, the same medicines can be dangerous to people, animals, and the environment when used, stored, or disposed of improperly. Neither septic tank systems nor municipal sewage and water treatment facilities eliminate all pharmaceutical contamination poured down drains or flushed down toilets. By disposing of drugs into a water system, the problem is not solved, but transferred to water, which we all depend upon. A wide range of pharmaceuticals have been found in rivers, streams, groundwater, and drinking water nationwide. The discussion will present AVMA's pharmaceutical disposal best management practices, resources, and professional and public outreach strategies.

Figure 6. Goat receiving an injection.

Food Animals, Veterinary Medicines, and Responsibilities: The Role of Livestock Producers, Pharmaceutical Guidelines, and Responsible Storage & Disposal

Author: Joe Cobb, DVM, Colbert Animal Clinic

Veterinary pharmaceuticals are used in food animals, our primary dietary sources for protein. In most livestock situations it is the farmer who administers and maintains these medicines on their farm. Ideally, the farmer has a client or veterinarian relationship and is administering these medicines based on the veterinarian's recommendations. There are also government regulations regarding use of pharmaceuticals in food (meat or dairy) animals with the hope that farmers are properly storing and disposing of remaining pharmaceuticals. Failure by the farmers

to maintain a working relationship with a veterinarian, to comply with regulations, and to properly dispose of excess or expired pharmaceuticals can result in penalties, unsafe food products for consumers, and a contamination of water sources. Such adulteration could affect food safety and aquatic life; and could be consequential for years and possibly generations. While none of this is intentionally done by farmers, we know of consequences with antibiotics, numerous food recalls for various reasons, and current and pending regulations regarding use of pharmaceuticals in food animals. There are ways to circumvent contamination of our consumable sources via educational endeavors such as prompting veterinarians to work closer with their clients and outreach initiatives through our Extension services that work with livestock.

Pharmaceuticals and Personal Care Products in the Environment: Extending Knowledge and Mitigation Strategies

Author: Nancy Holm, *Assistant Director, Illinois Sustainable Technology Center*, University of Illinois at Urbana-Champaign, Prairie Research Institute

Co-Authors: Wei Zheng, Laurel Dodgen, Elizabeth Meschewski, Michael Plewa, Justin Pals, Grace Maurer, & Sulagna Chakraborty

PPCPs as well as steroid hormones have been detected in many of the lakes, rivers, and streams in the United States, though usually at very low levels (ng/L - ug/L). The occurrence of these contaminants in groundwater and surface water impacts water quality and can cause a variety of negative effects on aquatic species. Two major sources of these contaminants are effluents from municipal sewage treatment plants and liquid manure from animal feeding operations. The treatment systems used are usually not designed to remove PPCPs or hormones. Our project is engaging in research, education, and outreach to develop mitigation strategies and increase public awareness of the issues involving PPCPs in the environment. The results ofour studies on the occurrence of contaminants in wastewater, generation of antibiotic-resistant bacteria, use of an inexpensive oil-sequestration water treatment method to reduce hormone concentrations, and assessment of the perspectives of the general public and other constituents about proper disposal of unused medications and waste treatment practices, will be discussed.

Assessing Impacts of the Synergistic Efforts to Reduce Pharmaceuticals in the Environment Program

Author: Denise Heubach, *Urban Regional Extension Agent*, Alabama Cooperative Extension System, Alabama A&M University

Co-Authors: Karnita Garner, Roosevelt Robinson, Phillip Carter, Allyson Shabel, Tamara Warren, Paul, Okweye, & Sampson Hopkinson

PPCPs have been detected in surface and groundwater, soils, biosolids, and drinking water all over the world. The potential toxicity and persistence of these chemicals remains unknown, and that uncertainty poses a big threat to the safety of humans, animals, and aquatic life. The Synergistic Efforts to Reduce Pharmaceuticals in the Environment (SerPIE) program was developed to help individuals understand the environmental safeguards germane to proper disposal of unwanted medicine. The measurable outcomes of SerPIE have improved environmental sustainability; increased resources to stakeholders, and decreased the amount of pharmaceuticals fated for the environment.

Figure 7. Goat receiving an injection. Stock image by ElChoclo

Hormones in the Environment: Causes, Consequences, and Biomarkers of Effects

Author: Ahmed Abdel-Moneim, *Graduate Student*, Purdue University

Co-Authors: Jessica Leet, Cecon T. Mahapatra, and Maria S. Sepulveda

Fish exposure to steroidal hormones, particularly during sexual differentiation, can result in abnormal gonadal development ultimately affecting fertility and fecundity rates. Lab studies were conducted to identify the impacts of sex steroids from concentrated animal feeding operations and waste water treatment plants using a combination of field and laboratory approaches. Field studies in Northern Indiana with smallmouth bass indicated prevalence of intersex close to 100% in some sites. Cause(s) for this condition remain unknown. Laboratory studies exposing fathead minnows throughout gonadal development to a mixture of hormones resembling those found in ditch water receiving tile and surface runoff from fields fertilized with manure, resulted in a high prevalence of ovarian cavities in testes, a sign of feminization. Studies with the model fish Japanese medaka are being conducted to develop a transgenic fish line that can detect the presence of chemicals that are estrogenic or androgenic. The goal is to develop high-throughput screening tools for identifying putative endocrine disruptors and their adverse effects in a sensitive, non-lethal and cost-effective way. Sources, fate, and effects of androgens and estrogens in aquatic systems will be discussed based on lab research.

Occurrence of Pharmaceuticals in Surface Water of Rural and Urbanizing Sub-watershed of Middle Tennessee

Authors: Ravneet Kaur, Anonya Akuley-Amenyenu, & Sam Dennis, PhD, *College of Agriculture, Human and Natural Sciences, Department of Agricultural and Environmental Sciences*, Tennessee State University

Pharmaceuticals have become important chemicals of emerging concern in surface water resources. On a national and regional scale, pharmaceutical drugs detected in surface water and sewage treatment facilities included steroids, and prescription and over the counter drugs including antibiotics, anti-depressants, and anti-inflammatory drugs. A study was conducted to monitor the incidence of pharmaceuticals in streams in the summer and fall of 2014 and the winter of 2015. The objective of the study was to determine the incidence of pharmaceuticals in surface water drained by rural and urbanizing watershed. Water samples were collected from Cumberland River and Stones River, which represented surface water drained by urban and rural watersheds of Middle Tennessee. The water samples were analyzed for the presence of pharmaceutical compounds using GC-MS. During sampling, water quality parameters of interest were collected in-situ with a multi-parameter sonde. While the scope of the study did not include determining the actual concentrations of the pharmaceuticals, their concentrations in the surface water were in parts per million to parts per billion ranges. The pharmaceuticals drugs detected included antibiotics, steroid derivatives, drugs used for treatment of alcoholism, anti-inflammatory compounds, type II diabetic control drugs, antifungal drugs, insect repellents, and pheromones.

Occurrence and Risk Assessment of Pharmaceutical and Industrial Pollutants in the Lower Tennessee River Basin, Alabama

Author: Paul Okweye, PhD, *College of Engineering, Technology & Physical Sciences, Department of Physics, Chemistry and Mathematics*, Alabama A&M University;

Co-Author: Karnita Garner, PhD, *College of Agricultural, Life and Natural Sciences*, Alabama Cooperative Extension System, Alabama A&M University

Pharmaceutical and industrial pollutants represent the newest pollutants discovered at Flint Creek and Flint River watersheds. Gas chromatography (electron capture detection and photo ionization) was used to detect all compounds. The instrumental detection limits were in the range of µg/kg. A modest to substantial amount of the pharmaceutical and industrial compounds were detected in samples collected from the watersheds during the winter season of 2015. Distribution of industrial pollutants revealed that more pharmaceuticals and gasoline components were present in Flint Creek than in Flint River. Results showed that pharmaceuticals (1549 µg /kg), gasoline products (644.9 µg /kg), volatile compounds (341.5 µg /kg), organic solvents (310.4 µg /kg), and other organic chemicals (2382.1 µg /kg) were present in these rivers. Pharmaceutical compounds (28.3 µg /kg) and human growth hormones (233.4-531.3 µg /kg) were present in samples from the depositional areas of the Flint Creek, suggesting anthropogenic sources. The results of the Ecological Risk Assessment or Hazard Quotient (HQ) for pharmaceutical pollutants for all sites indicated potential for adverse ecological effects; a more thorough study is necessary. The findings from this study will fill an existing gap in knowledge, and will allow environmental agencies to improve management decisions and develop meaningful guidelines for protecting Alabama's water resources.

Estradiol: An Estrogen Hormone Replacement Found in Surface Water in Tallahassee, Florida

Author: Odemari Mbuya, PhD, *Professor,* Florida A&M University, Center for Water and Air Quality

PPCPs are chemicals used by individuals for personal health or cosmetic reasons or used by agribusiness to enhance growth or health of livestock. PPCPs comprise a diverse collection of thousands of chemical substances, including prescription and over-the-counter therapeutic drugs, veterinary drugs, fragrances, and cosmetics. Concern is growing over the contamination of the environment with pharmaceutical residues. PPCPs are applied externally or ingested by humans, and are used for pets and other domestic

animals, especially as feed additives. An exploratory study to find the presence of two pharmaceuticals (Estradiol and Fluoroquinolones) in surface water bodies (creeks, streams and lakes) around Tallahassee was conducted. Estradiol is a form of the hormone estrogen that is administered as part of a hormone replacement therapy for women going through menopause. The hormone can be given through injection, oral tablet, transdermal patch, or topical spray or gel. Fluoroquinoones is a class of antibiotics in clinical use that are direct inhibitors of bacterial DNA synthesis. Fluoroquinolones inhibit two bacterial enzymes, DNA gyrase and topoisomerase IV, which have essential and distinct roles in DNA replication. The quinolones bind to the complex of each of these enzymes with DNA; the resulting complexes, including the drug, block progress of the DNA replication enzyme complex. Ultimately, this action results in damage to bacterial DNA and bacterial cell death. Eleven out of 15 sites tested were positive for estradiol, ranging from 3.02 ng L-1 (parts per trillion) to 5.97 ng L-1. However, all sites tested negative for Fluoroquinolones.

Adsorption and Photolysis of Selected Antibiotics in Soils, Plants and Water

Author: Asmare Atalay, *Research Professor and Soil Scientist*, Agricultural Research Station, Virginia State University

Co-Authors: Kevin Clairborne & Brodie Whitehead

Antibiotics are used in food animals to enhance growth, prevent diseases, and increase feeding efficiency. Large amounts of prescription antibiotics are also being consumed by humans to combat infection and other diseases. To make them more effective, most antibiotics are usually prescribed in high dosages. However, about 50-90% of consumed antibiotics are excreted from the body. Consequently, significant quantities of residual antibiotics are finding their ways into surface waters and soil systems. Rivers that receive water treatment plant effluents from urban areas and those that receive runoff from confined animal operations are especially loaded with high levels of varied antibiotics. Runoffs from agricultural fields that receive manure as supplemental fertilizers also contribute to the antibiotic dilemma. This research examined soil adsorption, microbial decomposition, photolysis, and plant uptake of four commonly prescribed antibiotics on four soils that varied in physicochemical properties. A factorial design was used for the experiment consisting of four antibiotics (amoxyciline, oxy-tetracycline, tetracycline, and tylosin), three extraction solvents (acetonitrile, ethyl acetate, and water), four soils (Bojac, Cullen, Bourne, and Levy), and three replications. Results obtained show that adsorption of antibiotics varied with soil and solvent type. Even though all antibiotics were soluble in water, extraction of antibiotics with water was a slow process. Photolysis at varied UV levels resulted in some breakdown of parent compounds. The rate of decomposition of antibiotics by soil organisms was highest in the initial week and decreased thereafter.

Using Ecological Processes to Remove Some Antibiotics from Livestock Wastewater

Author: Chen Xiongwen, PhD, *Associate Professor, Dept of Biological & Environmental Sciences*, Alabama A&M University

The global use of antibiotics has become a major threat because of the increasing evidence for their ecotoxicological and health effects. Removal of the antibiotics is cost prohibitive and also a challenge in technical perspective. Proper ecological processes could be used to remove some antibiotics effectively. Some evidences of using solar radiation, microorganism, plant biodiversity and soil absorption and degradation will be discussed. The future applications of using ecological processes in Alabama are proposed. Using ecological processes to remove some antibiotics may be a practical approach to treat livestock wastewater.

Willingness to pay for a Medicine Disposal Programs in the Midwest: A Double Hurdle Approach

Author: Sofia Vielma Delano, *Graduate Student*, Purdue University

Co-Author: Kwamena Quagrainie

There have been increasing concerns about the environmental impact of pharmaceutical accumulations in surface water over the last two decades. Several states in the nation have implemented medicine take-back programs to help mitigate problems associated with unused pharmaceuticals in households. States bordering the Great Lakes have particularly been concerned about the impact of accumulations of pharmaceuticals. This study assessed the value of a pharmaceutical collection program based on the willingness to pay (WTP) per prescription as well as WTP per visit of current and potential consumers of the program. We found that 60% of the population is willing to participate in a collection program, while 40% are willing to pay to participate in the program. The estimated mean WTP from the Double Hurdle Model is $1.25 per prescription and $2.33 per visit. The mean WTP for those willing to participate (including willingness to pay zero) is $0.53 per prescription and $1.03 per visit. Total annual benefits for such programs are estimated to be $21.6 million when considering WTP per prescription, and $20.7 million for a single drop-off per year when considering WTP per visit. This information will help better inform program providers, researchers, policymakers, and other interested parties.

Poster Presentation Abstracts

Pharmaceuticals & Personal Care Products

Consumers see the Importance of Medication Disposal, but Don't Know or Seek Information about Proper Methods

Author: Mike Tringale, *Senior Director*, Consumer Healthcare Products Association

Co-Authors: John Punzi & Colleen Creighton

Over-the-counter (OTC) products comprise the majority volume of medicines purchased by consumers. Proper disposal of expired and unwanted OTCs is important for safety and environmental concerns. To identify consumer awareness, knowledge and behavior of disposal, the Consumer Healthcare Products Association Educational Foundation engaged Nielsen Research/Harris Poll for a national survey February 3-9, 2015, of adults age 18 years and older who used and/or purchased OTC medicines the past 6 months. The online instrument included 49 questions, 9 regarding disposal. Data were weighted for propensity to be online and United States proportions for all demographic variables. From n=2002 respondents (54% female), 95% used/purchased medical pills/tablets/capsules, 92% personal hygiene drugs, 73% vitamins/supplements, 50% medical liquids, 48% topical medical creams/ointments. 50% of respondents typically dispose of OTCs in household trash, 20% flush. Only 7% were returned to local take-back programs or pharmacies (6%). Ninety percent agree that the way someone disposes of OTCs is important, and 49% wished they knew more about proper disposal, but 62% have never sought information. Conclusions: Half of consumers already dispose OTCs in household trash, which usually terminates in EPA-regulated landfills. But too many continue to flush OTCs and too few utilize existing take-back programs. There is a need for better public education about proper disposal.

The Role of Pet Owners on Unused Pharmaceuticals and Personal Care Products Entering the Aquatic Environment

Author: Linda Tucker Serniak, *Graduate Student*, Oregon State University

Co-Authors: Kayla-Maria Martin, Danielle Goodrich, Noelle Moen, Samuel Chan & Tania Siemens

PPCPs contain compounds that are potentially hazardous to watershed health, yet there is little understanding on how PPCPs are reaching our waterways. Oregon State University and the Oregon Sea Grant College Program launched a national survey aimed at learning the decisions on the use, storage, and disposal of human and pet PPCPs. Survey takers treated both their pets and human PPCPs similarly in storage and disposal, and the majority of respondents disposed of their PPCPs in a way which could potentially lead to entry into waterways. However, respondents also indicated that they valued clean water and air and want to take action to prevent PPCPs from polluting the environment. If provided proper information, many are willing to share information on proper use and disposal. Exploratory factor analysis revealed that respondents mostly looked to government agencies and public utilities as sources of credible information, followed by social and commercial sources. These results indicate that government agencies have the opportunity to guide outreach options that enable safer use, storage, and disposal practices for PPCPs. Safer and accessible stewardship and disposal practices will help to reduce the risks of impacts on aquatic life and water quality.

The Medicine Chest 2.0: Reaching PPCP Reduction through Education

Author: Kirsten Walker, *Environmental Educator*, Illinois-Indiana Sea Grant

The Medicine Chest addresses PPCP pollution using a curriculum comprised of multidisciplinary, standards-based classroom materials. It also includes sample stewardship activities and background information for educators and high school students on how the improper disposal of unwanted medicines can be harmful to people, pets, and the environment. Through the multifaceted service-learning program presented in The Medicine Chest, students will be empowered to take action that will serve as a catalyst to help communities reduce the impacts from improper storage, use, and disposal of pharmaceuticals. The goals for The Medicine Chest are to: offer comprehensive lessons on the issues surrounding PPCP disposal, incorporate a variety of educational approaches for instructing high school-level students,

support community stewardship by offering creative project examples and guidance that will inform the public about appropriate disposal practices, and explore a variety of careers that work with PPCPs.

SerPIE Mentorship Program

Authors: Paul Okweye, PhD, *Department of Chemistry, Physics and Mathematics,* Alabama A&M University and Tamara Warren, PhD, *Alabama Cooperative Extension System,* Alabama A&M University

The Alabama Cooperative Extension System and Alabama A&M University hosted the first SerPIE_ASEMP (Synergistic Efforts to Reduce Pharmaceuticals in the Environment_Agricultural Science & Extension Mentorship Program) in the summer of 2015. The six-week mentorship program was designed to orient underrepresented students towards careers in science and Extension that focus on emerging issues like pharmaceuticals in the environment. SerPIE_ASEMP was offered June 15-July 24, 2015, and consisted of a nationwide search, targeting undergraduate STEM (science, technology, engineering and mathematics) majors with a minimum GPA of 3.0/4.0. Six students were selected and placed with mentors from diverse STEM backgrounds. The students learned first-hand the responsibilities of serving the community-at-large and the importance of combating issues like pharmaceuticals in the environment. They were engaged in classroom and laboratory exercises and participated in field and site visits, workshops, and in-service learning projects. The program culminated with formal presentations summarizing the mentees' experiential learning experience. Overall, they gained a better understanding of the impacts that PPCPs have on animal, human and environmental health and the best management practices necessary to minimize the risk posed by these hazardous chemicals. Evaluation of the mentees revealed significant knowledge gains concerning PPCP issues (88%) and increased interest in Extension and science careers (92%) (n=6).

Assessing levels of Estradiol and Fluroquinolone in Surface Water of the Huntsville Spring Branch Watershed

Authors: Karnita Golson-Garner, PhD, *Alabama Cooperative Extension System*, Alabama A&M University; Paul Okweye, PhD, *Department of Chemistry, Physics & Mathematics,* Alabama A&M University; and Teferi Tsegaye, PhD, *College of Agriculture, Food Science & Sustainable System,* Kentucky State University

The contamination of aquatic ecosystems by PPCPs in the environment is a serious issue. PPCPs are described as any product used by individuals for personal health or cosmetic reasons or used by agribusiness to enhance growth or health of livestock (USEPA, 2012). They have multiple sources and range from prescription and over-the-counter therapeutic drugs to cosmetics. With the development of new analytical techniques that result in the detection of minute concentration levels, PPCPs are being detected in the environment by scientists worldwide. The objective of this study was to assess levels of targeted pharmaceuticals in surface water of the Huntsville Spring Branch Watershed. Fifteen sites consisting of streams, lakes and ponds were selected based on location and geo-referenced using a Garmin GPSMAP® 78sc. Triplicate samples were collected and placed into 40 ml amber bottles. The samples were shipped overnight via courier and analyzed at the Kentucky Geological Survey Laboratory for the drugs, estradiol and fluroquinolone using Estradiol 17B by Immunoassay and Fluoroquinolones by ELISA. Although 4 of 15 sites showed detections for estradiol, no detections were observed for Fluoroquinolone. Certain hormones have been shown to be problematic for aquatic systems; hence, additional sampling is needed to further investigate estradiol levels.

Development of the Synergistic Efforts to Reduce Pharmaceuticals in the Environment Program

Authors: Phillip Carter, Karnita Garner, PhD, Denise Heubach, Roosevelt Robinson, Allyson Shabel, Tamara Warren, PhD, *Alabama Cooperative Extension System*, Alabama A&M University; and Paul Okweye, PhD, *Department of Physics, Chemistry, & Mathematics*; and Sam Hopkinson, PhD, *Department of Biological & Environmental Sciences*, Alabama A&M University

PPCPs have been detected in surface and groundwater, soils, biosolids, and drinking water around the world. The potential toxicity and persistence of these chemicals remains unknown, and that uncertainty poses a big threat to the safety of humans, animals, and aquatic life. The Synergistic Efforts to Reduce Pharmaceuticals in the Environment (SerPIE) program was developed under the auspices of the Alabama Cooperative Extension System's Urban Affairs & New Nontraditional Programs unit at Alabama A&M University in 2012. The program aims to improve literacy concerning local environmental health issues by offering resources that enable citizens to safeguard their homes and the environment from PPCPs and accentuate the benefits of using safe, effective methods to dispose of expired and unwanted pharmaceuticals. It provides educational information via workshops, seminars and demonstrations to help individuals protect their home and environment. Average participants' knowledge before the workshops was rated low to moderate compared to a rating of very high after the workshops. Overall, SerPIE activities resulted in a decrease in the amount of pharmaceuticals fated for the environment (i.e. water supplies); a decrease in pharmaceuticals stockpiled in homes; and reduced accessibility and potential misuse of pharmaceuticals.

Figure 8. Water treatment plant. Stock image by tuachanwatthana

The Spatial Distribution of Pharmaceutical Drugs in the Southeastern United States

Authors: Teferi Tsegaye, PhD, *Professor*, Kentucky State University

Co-Author: Maifan Silitonga

Pharmaceutical drugs are becoming primary concerns threatening both surface and ground water resources. The purpose of this study was to evaluate and determine the spatial distribution of pharmaceutical drugs across ten states in the Southeastern region of the United States. Our preliminary data indicates that the amount of estradiol concentration detected in the water samples varies by watershed within the respective state. The average concentration level found for detectable estradiol was 4.74 parts per trillion (ppt). The highest concentration level detected was 110 ppt. The average value of detectable fluoroquinolones was 0.035 parts per billion (ppb) for all the states. The highest concentration detected was 0.68 ppb. Our preliminary data analysis indicated that the presence of these pharmaceutical drugs in surface water varies from state-to-state.

Water Resources

Soil Moisture Modeling Using Artificial Neutral Network

Authors: Jay Gangasani, *PhD Student, Dep of Natural Resources & Environmental Sciences*, Alabama A&M University

The prediction of soil moisture is not only useful in agricultural applications, but also in archeology, soil erosion, drought forecasting models, dust control, and landslide studies etc. An artificial neural network-based or ANN algorithm was implemented and tested for soil moisture estimation. The research focused on developing moisture estimation capability by using an ANN-based model. The ANN model was calibrated (trained) and validated (tested) with soil moisture profiles measured from the Alabama Mesonet (ALMNet). The performance of the ANN model was be evaluated by direct comparison between the soil moisture estimated by ANN model and the ALMNet measurements, and by examining the correlations between them. Strong correlations were observed between the ANN estimates and ALMNet measurements indicating that the ANN model is a good estimator of soil moisture content.

Drinking Water Contaminants: Lead and Copper/ Disinfection Byproducts

Authors: George M. Cox, *Chief, Ground Source Section*, Alabama Department of Environmental Management

Lead can cause damage to the brain, red blood cells, and kidneys, especially in children. Copper can cause stomach and intestinal distress, liver and kidney damage, and complications of Wilson's disease. Public water systems remove sources of lead in distribution systems as well as treat their water to reduce its corrosivity. Exposure to high levels of disinfection byproducts (DBPs) over long periods of time may cause health problems, including damage to blood and kidneys. Public water systems use a multilevel approach to reduce the DBPs in their drinking water.

Identification and Enumeration of E. coli and the Impact of Climate Change and Variability to determine the Water Quality in the Flint Creek Watershed

Authors: Gabrielle L. Russaw, Research Student, Alabama A&M University

Studies are being conducted to evaluate the water quality of the Flint Creek Watershed (FCW) located in Southeast Lawrence County, Western Morgan County, and the Northern region of Cullman County in Alabama. FCW is a major tributary to the Tennessee River and also to the Wheeler Wildlife Reservoir. The major sources of waste discharge into the watershed are from surrounding communities, and public and private facilities within the area. The presence of cattle farms, goat farms, and cropland may be linked to the contamination of soil and water resources. This particular study evaluated the impacts of nutrients (nitrogen, phosphorus, and mercury), climate change/variability and land use and demographic change on the presence of E.coli, a fecal indicator bacterium in surface water of the FCW. Analysis was conducted on three (3) sites of Flint Creek (FC): Red Bank Road (Site 1), Highway US-31(Site 2), and Vaughn Bridge Road (Site 3) with six (6) samples taken in triplicate once a month for two years. We hypothesized that the levels of E.coli fecal coliforms would be higher in the warmer months of May-September and decrease from October-April. Additionally, changes in climate and land use and the concentration for nutrients would have a significant impact on overall bacterial levels of E.coli.

Influence of Eutrophication Gradient on Organic Phosphorus forms at Florida Everglades

Authors: Lucy Ngatia, *Researcher, Center for Water and Air Quality*, Florida A&M University

Co-Authors: A. E. Normand, K. S. Inglett, J. Rocca, and K. R. Reddy

Phosphorus (P) cycling influences plant productivity in sub-tropical wetlands but little is known about the P forms along eutrophication gradient. Our objective was to determine the P forms along eutrophication and soil profile gradient. Soil samples were collected from the Florida Everglades WCA-2A eutrophic (F1), transition (U3R) and pristine (U3S) sites. Sampling was done at 0-5, 5-10 and 20-30cm depth. We used sequential P analysis and solution 31P nuclear magnetic resonance to characterize P forms. Results indicated that both eutrophic and transition were dominated by NaOH extractable P while the pristine site was dominated by both HCl P and residue P. Top 0-5cm depth in the eutrophic site contained Orthophosphate, phosphomonoester, DNA, polyphosphate and pyrophosphate P. But, polyphosphate was missing in the subsequent depth 5-10cm and 20-30cm. The transition site was dominated by orthophosphate, phosphomomoester, DNA and pyrophosphate all P forms decreased with depth. While the pristine site was dominated by orthophosphate in the calcareous upper depth (0-5 cm) and 20-30cm, 5-10 cm depth was dominated by orthophosphate and phosphomonoester. The study highlights the importance of organic P in eutrophic sites and inorganic P in pristine sites as a source of plant nutrition.

Environmental and Health

Urea Production Mechanisms in Drainage Ditch Sediments in a Coastal Agroecosystem

Authors: Arthur Allen, PhD, *Professor,* University of Maryland Eastern Shore

Co-Authors: Mason King, Ray Bryant, Eric May, Lindsey Hughes, Louis Saporito, and Fawzy Hashem

Urea is a ubiquitous agricultural fertilizer implicated in the development of harmful algae blooms. However, research shows that large-scale movement of urea fertilizer to surface waters is unlikely, despite observations of high concentrations in coastal plain drainage ditches. There is evidence that stagnant agricultural drainage ditches generate urea-N once flow recedes following rainfall. The potential for autochthonous urea-N formation was assessed by field monitoring and an indoor mesocosm experiment. The experiment used sediment samples from drainages incubated with prepared solutions to simulate stagnant, saturated field conditions. Measurable urea-N concentrations appeared in mesocosm surface water within eight hours of incubation across all sediments and conditions, while control mesocosms produced little urea. The highest concentrations of urea-N occurred with warmer temperatures and generated by agricultural drainage ditches; lower urea concentrations were generated by sediments from forest and wetland drainages. These results support a hypothesis that urea is formed by ditch processes. It was postulated that urea-N formation is driven by microbial activity in ditch sediments that affect urea cycling and movement. While urea fertilizer may not leach directly from fields, urea from drainage ditches may modify downstream N pool composition, and thereby alter primary producer community structure to favor harmful algae blooms.

Urban Legends: Food Myths and GMOs

Authors: Rudy Pacumbaba, PhD, *Extension Horticulture Specialist, Alabama Cooperative Extension System*, Alabama A&M University

Co-Authors: Lisa Kriese-Anderson, PhD & Alex Tigue

The unknown always invokes fear. It is a natural response in everyone, especially when we hear of genetically modified (GM) foods or genetically modified organisms (GMOs). GM foods and GMOs can be especially confusing because they are shrouded in a cloud of unfamiliar science. As a result, a lot of popular online information is often misinterpreted, taken out of context, or completely fabricated. The public interest and concerns about GM foods and GMOs has reached a point where confusion has been fueled by conflicting reports about the use, regulation, and safety of these products. The agriculture and food industries are the primary users of these products and with the oversight and regulation by government agencies such as the United States Department of Agriculture, the Food and Drug Administration, the Environmental Protection Agency, and the Animal and Plant Health Inspection Service, these products have been tested and determined safe for public introduction and use. However, why is there so much conflicting information found online arguing to the contrary? With more products being developed and potentially introduced, public consumers need to better understand what is fact or fiction.

The Effect of Processing on the Sensory Attributes of the Common Sweet Potato (Ipomoea batatas) Found in Alabama

Author: Terri N. James, *Graduate Student*, Alabama A&M University

Co-Authors: Patti Coggins & Lamin Kassama

The sweet potato (Ipomoea batatas) is an important root crop that flourishes in the warm climates areas around the world and they are good sources of essential dietary fiber and carbohydrates. The effect of microwave cooking and freeze drying on the sensory attributes of two cultivars of orange flesh sweet potatoes (OFSP) (Bell View and Evangeline) was evaluated. The third cultivar (Covington) was subjected to baking to evaluate the degradation kinetics over time. Subjective testing by quantitative descriptive analysis (QDA) was performed to determine attribute intensity of changes in the appearance, flavor and taste of the sweet potatoes. Instrumental color analyses were performed to discern visual differences. Utilizing a sensory instrument developed at Alabama A&M University, six panelists were trained for the sensory evaluation. Students' t-test displayed significant differences ($P < 0.05$) for the lightness, redness, and yellowness of the microwave cooked Evangeline cultivar, but only the lightness and yellowness of the microwave cooked Bell View Cultivar. QDA data were analyzed using Analysis of Variance (ANOVA). Both cultivars displayed significant difference ($P < 0.05$) for the flavor component. The rate of color degradation for the blanched and baked Covington cultivar (0.08/s) exceeded that of the raw baked Covington (0.12 /s). The study concludes that freeze drying is a suitable preservative method for microwave cooked sweet potatoes and blanching and baking enhance the sensory attributes of OFSP.

Environment and the Challenges of Nigerian National Petroleum Cooperation in Nigeria

Authors: Roseline Ekhaise, *Lecturer,* School of Vocational and Technical Education, College of Education

Co-Author: Paul Okweye

Petroleum production and export play a dominant role in Nigeria's economy for about 90% of her gross earnings. This dominated role has pushed agriculture, the traditional mainstay of the economy, to the background. The National Petroleum Corporation (NNPC) found in 1977 through the merger of some of the departments of the Ministry of Petroleum Resources and the old NNPC, is charged with the responsibility for upstream and downstream development, regulating, and supervising the oil industry on behalf of the Nigerian Government. Since the discovery of oil in Nigeria in the 1950s, the country has been faced with the negative environmental consequences of oil development. Nigeria's main environmental challenges result from oil spills, natural gas flaring, and deforestation. Industrialization is vital to a nation's socio-economic development as well as its political structure in the comity of nations. It provides ready employment opportunities for a good percentage of the population in medium to highly developed economies. It is recommended that nongovernmental organizations, international oil companies, and well-spirited individuals will have to work together to slow the degradation of Nigeria's environment and take steps to mitigate the problems that a half century's worth of oil production already has caused.

Green Gas Emission from Alabamian Transport

Author: Ngozi Ajufo, *Research Assistant*, Alabama A&M University

Co-Author: Jacob Oluwoye

Considerable attention has been deviated in recent years to the problem of global warming and associated increase in greenhouse gas emission as a result of human activities. Hazardous air pollutants from on road vehicles are major contributors of pollution in Alabama. Both heavy duty and light duty vehicles contribute to the emission of volatile organic compound particles to the atmosphere. On-road vehicle emissions increase the quantity of deterioration in ambient air quality, especially in urban areas. In addition, nitrogen oxides and carbon monoxide from on-road mobile sources can cause respiratory problems and have other harmful health effects. The goal of this research is to examine and describe the physical and chemical aspects of transport related air pollutant. On-road vehicle emission of carbon monoxide, nitrogen oxides, and volatile organic compounds throughout Alabama were examined through secondary data extracted from the National Emission Inventory, and Region 4 of the United States Environmental Protection Agency. In conclusion, emissions from road traffic are being reduced substantially by the introduction of modern technology.

Trend Analysis on the Demographic Aspects in the Effects of Weather Patterns on Traffic Safety

Author: Lady Franciscar Kassama, *Research Assistant*, Alabama A&M University

Co-Author: Jacob Oluwoye

Extreme weather patterns have had a significant projected effect of climate change. Road safety is an area where shifts in weather patterns due to climate change could be significantly impacted. Research on road safety has been undertaken to derive corrective actions to improve the situation by understanding the complexity of factors. This study aims to analyze, report and describe the nationwide secondary data on the vehicular crashes, related injuries, and fatalities that have occurred during inclement weather conditions on United States road networks from 1990- 2014. Data on crashes and related injuries were drawn from National Highway Traffic Safety Administration. The t-test, analysis of variance (ANOVA) and Mann-Kendall Test were employed in analyzing the data. In 2014, the age group 15-39 had the most accidents during adverse weather conditions. During the same year, 42% of all the crashes during adverse weather conditions involved the white population, 6% among the black population, and 1% among the Asian population.

In conclusion, fatal and serious accidents takes place on all road types and are expected to rise due the adverse effects of climate change, which for planning policy and transportation management purposes, demographic factors would also have to be considered.

Karnita Golson Garner, PhD, *Extension Environmental Specialist*, Alabama A&M University; **Paul Okweye, PhD**, *Associate Professor of Chemistry*, Alabama A&M University; **Sarah Zach**, *Pollution Prevention Specialist*, Illinois-Indiana Sea Grant; **Laura Kammin**, *Outreach Program Leader*, Illinois-Indiana Sea Grant; **Dr. Sampson Hopkinson**, *Associate Professor*, Alabama A&M University; and **Dr. Sam Dennis**, *Professor*, Tennessee State University

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