VOL. 16, 2019

Re:search

A MAGAZINE OF THE AGRICULTURAL RESEARCH PROGRAM IN THE COLLEGE OF AGRICULTURE AND ENVIRONMENTAL SCIENCES AT NORTH CAROLINA AGRICULTURAL AND TECHNICAL STATE UNIVERSITY

Protecting Poultry

INSIDE

NORTH CAROLINA AGRICULTURAL AND TECHNICAL STATE UNIVERSITY

AGRICULTURE AND ENVIRONMENTAL SCIENCES

Re:search

A magazine of the Agricultural Research Program in the College of Agriculture and Environmental Sciences at North Carolina A&T State University

Dr. Harold L. Martin Sr., Chancellor
Dr. Mohamed Ahmedna, Dean and Research Director, College of Agriculture and Environmental Sciences
Dr. Shirley Hymon-Parker, Associate Dean, Agricultural Research
Dr. Antoine Alston, Associate Dean, Academic Studies
Dr. Rosalind Dale, Associate Dean and Administrator, Cooperative Extension

Produced by Agricultural Communications:

Interim Director: Daniel M. Nonte
Writers: Lydian Bernhardt, Robin Adams Cheeley, Laurie Gengenbach, Daniel M. Nonte, Mark Tosczak
Editor: Daniel M. Nonte
Photographer: James Parker
Graphic Designer: Joshua Loftin

Send change of address and correspondence to:
Agricultural Communications
C.H. Moore Agricultural Research Station
North Carolina A&T State University
Greensboro, NC 27411

On the cover: Broiler chicks are among the poultry that can benefit from sprayed dried plasma added to their feed as a means of enhancing their immune systems and controlling salmonella infections.

6,000 copies of this public document were printed on recycled paper at a cost of $10,014, or about $1.67 per copy.

The projects described in this document are supported in whole or in part by the USDA National Institute of Food and Agriculture (NIFA). Its contents are solely the responsibility of the authors, and do not necessarily represent the official views of NIFA.

Re:sear

North Carolina Agricultural and Technical State University is an 1890 land-grant, doctoral, high research activity university dedicated to learning, discovery and community engagement. The university provides a wide range of educational opportunities from bachelor's to doctoral degrees in both traditional and online environments. With an emphasis on preeminence in STEM and a commitment to excellence in all its educational, research and outreach programs, North Carolina A&T fosters a climate of economic competitiveness that prepares students for the global society.

Mission

The College of Agriculture and Environmental Sciences provides opportunities for individuals from diverse backgrounds to achieve excellence in the food, agricultural, family and environmental sciences through exemplary and integrative instruction, and through scholarly, creative and effective research and Extension programs.

3 Sharing knowledge about hemp

20 Baking a tastier bran bread

14 Boosting poultry health

ch

A magazine of the Agricultural Research Program in the College of Agriculture and Environmental Sciences at North Carolina Agricultural and Technical State University

Shirley Hymon-Parker, Ph.D.

In the CAES, we turn research into *real-world solutions*

The College of Agriculture and Environmental Sciences thrives on research. In our labs and in the field, we're engaged in practical research that enriches the lives, the land and the economies of our state and nation.

N.C. A&T is proud to be classified by the Carnegie Classification System – the framework for classifying colleges and universities in the U.S. – as a doctoral, high research activity university dedicated to learning, discovery and community engagement. Last year, our university ranked in the top three institutions in the 17-member UNC System for attracting research funding, and the CAES consistently leads N.C. A&T in external funding, with more than $21 million annually in recent years.

As proud as we are of these credentials, we realize that it's not research for its own sake. We're committed to research that delivers real-world solutions and makes a difference for the people who we serve as a land-grant institution.

In the words of Leon Moses '80, our University Farm superintendent, "Research is all well and good, but it matters most when you put it in front of somebody and it helps them."

Luckily, outreach is one of our specialties.

Take our work with industrial hemp, for example. This potentially lucrative cash crop could transform farming in North Carolina. We're hard at work researching the best growing methods and passing on what we learn to our farmers at field days and through Cooperative Extension.

We're also working on ways to improve animal health. At the University Farm's Poultry Unit, we're researching how to protect chickens from salmonella bacteria. That's important to North Carolina, one of the nation's top poultry producers.

We're working to improve human health, too. Our lab at the Center for Excellence in Post-Harvest Technologies in Kannapolis is biting into bran, testing ways to make a better bread. On campus, we're investigating coatings that can reduce the fat in fried foods while keeping the crunch.

At the same time, we're preparing students for bright futures. Participants in our Undergraduate Research Scholars Program are designing and leading their own independent research projects. Once they graduate, Aggies are changing the world.

Michael S. Regan '98 was appointed by Gov. Roy Cooper in 2017 as the secretary of the Department of Environmental Quality. He started his education here, as an undergraduate earth and environmental sciences major. Today, he works to enact the governor's environmental initiatives, including a bold new plan to address climate change.

We've unveiled a bold new plan of our own, CAES Preeminence: Horizon 2023. We have dedicated ourselves to greater collaboration across disciplines to achieve ambitious goals for research.

Guided by this plan, we will continue to build on our history of innovation as we work to meet the food challenges of a hungry planet. Our impact as a college will continue to grow.

Sincerely,

Shirley Hymon-Parker, Ph.D.

Re: information sjhymonp@ncat.edu

HEMP SPREADS ITS ROOTS *INTO* N.C. AGRICULTURE

Researchers learn hemp's secrets to unlock its potential as a cash crop.

The economic picture of industrial hemp as a high value specialty crop continues to come into focus in North Carolina.

Field trials to determine best practices for growing the potentially lucrative crop are in their second year. In researchers' surveys, farmers – most of whom have never had any association with hemp – indicate a willingness to learn and an enthusiasm for the subject.

All that's missing are the certainties: What variety of the species to grow, when to sow and harvest, when and how to fertilize and – most important – what factors influence the level of cannabidiol (CBD), a hemp extract widely believed to have medicinal properties.

Arnab Bhowmik, Ph.D., is an assistant professor of soil science in the Department of Natural Resources and Environmental Design. He and his team are coming closer to providing farmers across the state with answers to their questions about hemp.

"This is a different type of crop than, say, corn or soybeans," said Bhowmik, who is one of the lead researchers on A&T's industrial hemp project. "This is a crop that relies on the growers' skills rather than on having large amounts of acreage, which most limited-resource farmers

abhowmik@ncat.edu yangg@ncat.edu sgy@ncat.edu

don't have anyway. Farmers can learn from our research and use it as a model."

Grown around the world for millennia, hemp was a common crop in the U.S. until 1937, when drug enforcement laws prohibited its cultivation because of its similarity to marijuana. Both plants are varieties of the species Cannabis sativa, but marijuana plants contain higher levels of the psychotropic agent tetrahydrocannabinol (THC). The THC concentration in industrial hemp must stay below 0.3%, according to federal and state laws.

The 2014 Farm Bill allowed industrial hemp to be grown again for research purposes; in 2015, the N.C. General Assembly legalized industrial hemp production as part of the state's pilot program. The law was updated in 2016 to establish a research program using the faculty and research expertise of the state's two land-grant institutions, N.C. A&T and NC State University, to determine the plant's viability as a cash crop.

The 2018 Farm Bill legalized the production of hemp and allowed it to be treated like any other agricultural commodity, although hemp farmers must apply for a license and pay an annual fee. Since then, interest in hemp has exploded among growers as well as consumers, with hundreds of licenses granted last year alone. As of early September, the state had nearly 1,300 licensed growers and nearly 800 registered processors, using more than 16,000 acres of field space and nearly 6 million square feet of greenhouse space.

Guochen Yang, Ph.D., a horticulture professor in the Department of Natural Resources and Environmental Design, helped conceptualize A&T's program. He also serves as a commissioner for the state's Industrial Hemp Commission, the group that develops the rules and licensing structure necessary for growers to cultivate hemp within federal laws.

"Hemp is booming in North Carolina right now," Yang said. "The number of hemp growers may this year catch up to the number of tobacco growers."

The versatile hemp plant can be grown

for food, rope, dietary supplements, paper, textiles, biodegradable plastics, biofuel and animal feed. But for small, minority and limited-resource farmers, the best profit comes from the plants' CBD oil, which has shown promise in treating a host of medical conditions, including anxiety, inflammation and insomnia.

Market demand is high for the oil, and so is growers' demand for information about how to grow hemp for maximum CBD yield. Research at A&T is currently focusing on growing plants for CBD.

Boosting the levels of CBD oil by letting plants stay longer in the field increases profitability. But as the plant grows, the level of THC grows, as well.

"Illegal THC levels are the farmers' big fear," Bhowmik said. "An entire season's worth of work and investment can be ruined by plants with too much THC. The N.C. Department of Agriculture and Consumer Services will destroy the entire crop."

To get the correct results above ground, Bhowmik said, start with what's below.

Soil science

"Before we start to grow anything, we need to know about the soil," he said. "Industrial hemp is, essentially, a new crop for us. So, first we need to evaluate its optimal soil conditions."

The first stage of A&T's hemp research is to conduct field trials. On a one-third-acre, experimental plot at the University Farm, Bhowmik and his team are testing the soil properties, yield and CBD content of two different hemp varieties at four different levels of fertilization. The team samples the soil and the plant tissues and analyzes them for nutrients. The team also tests the buds of female plants, where CBD oil is found, throughout the growing season. The agronomic study is funded by a grant from the U.S. Department of Agriculture.

Soil is more than just the medium that physically supports the plant; it feeds the plant

Arnab Bhowmik, Ph.D., is testing soil samples to determine the best mix for hemp cultivation.

and influences its composition throughout the growing season. Proper soil management practices not only grow healthier plants, but also raise CBD levels and keep THC under control.

Good soil management practices can include putting hemp in a crop rotation that also includes other cash crops and cover crops, such as rye or clover; using mulches on the fields to reduce weeds; and adding organic matter, such as crop residues and animal waste, to the soil to improve its nutritional qualities.

"We try to cut the costs of chemical fertilizer, and avoid over-fertilization, by making the soil healthier to start with," Bhowmik said. "We say, 'Feed the soil so that it can feed the plants.' "

Fertilizers' effect on CBD and THC levels is one of the many unknowns still surrounding hemp cultivation.

"We've learned a lot," Bhowmik said. "It's going to take time to answer all the questions, but we're making progress. The soil is the determining factor."

The second stage of hemp research involves outreach workshops and field demonstrations. Those are funded in part by a grant from the Golden LEAF Foundation, a nonprofit devoted to advancing the state's economy, particularly in areas that were once tobacco-dependent. Extension Horticulture Specialist Sanjun Gu, Ph.D., and his assistants have conducted five hemp workshops around the state, as well as providing training materials, publications, conferences and additional workshops. A conference for hemp growers is planned for December.

Sanjun Gu, Ph.D.

Informing farmers

Farmers are eager for the information. In September, 118 people from across the state – some new to hemp cultivation, some new to any kind of farming – came to the university's Industrial Hemp Field Day to learn the current best practices.

While plots of bushy, 4-foot, bright green hemp plants waved in the breeze, A&T researchers described cultivar varieties, fertilization rates, pest control practices, soil modifications and

LEFT: More than 100 current and prospective hemp farmers came to the University Farm for the Industrial Hemp Field Day in September.

RIGHT: Maximizing CBD production while keeping THC levels below .3% is one of the projects for Bhowmik and his team.

BELOW: After going through a trimming machine, most of the leaves and stems have been removed from the hemp buds.

other successful growing strategies.

Although hemp is a new crop to the state, its cultivation is similar to that of a familiar friend, the tomato, research specialist John Ivey told the crowd.

"The nutritional requirements, fungal responses and pest management are very similar," Ivey said. "You have to prune them. You have to sucker them. To get a high-value crop, you have to put in high labor."

A few years ago, hemp was thought to be a low-maintenance crop. Field tests and research have proven that to be false, Ivey said.

"Don't bite off more than you can chew," he cautioned the farmers. "Growing them takes a lot of maintenance, and at harvest time you have to think of labor costs, curing and drying costs, storage costs. When it comes to deciding what to plant, our advice is to start small."

On another part of the farm, a hemp study funded by a grant from the Golden LEAF Foundation is comparing plants grown in open fields to those grown in high tunnels. The tunnels, hoops covered in plastic, are used to trap heat and extend the growing season. Being a summer crop, hemp grew more vigorously in the tunnel than in the field. However, the hot and humid environment also resulted in higher disease pressure in the tunnel. The research continues.

With each new solution comes new questions: If fertilizer helps the plants grow, will it increase their CBD production? In the global market, if current tariffs remain in place, will cultivation for fiber – now done primarily in China – become lucrative here?

"Some growers want to get quick money, but hemp doesn't go that way," Yang said. "There are many gray areas still to be decided, and then, the regulatory climate has to be beneficial."

One such gray area is the issue of transporting hemp products across state lines. Although the product is now legal, each state can impose

Attendees at Industrial Hemp Field Field Day tour a high tunnel where hemp was grown as part of a project led by Sanjun Gu, Ph.D.

its own regulations, creating a potentially crippling tangle of laws for growers and distributors.

Other legislation deals with which parts of the plant are marketable. Earlier this year, the North Carolina legislature passed a ban on smokable hemp flowers. The popular product is used by some as a delivery system for CBD and its medicinal properties. Law enforcement, however, has called for the ban repeatedly, citing hemp's similarity to marijuana and claiming that prosecuting marijuana cases is more difficult if smokable hemp is legalized.

Guochen Yang, Ph.D.

Despite these obstacles, hemp hopes remain strong, and demand remains high. The sale of hemp-related products is expected to expand from the current level of $700 million to $1.8 billion by 2020, according to the Congressional Research Service. Many researchers and agriculture professionals remain hemp advocates, as well.

"Hemp would be a real benefit for North Carolina farmers," Yang said. "It's potentially a high-dollar, sustainable domestic crop such as we haven't had in a while. There are other ways, besides a ban, to overcome these issues."

Research into best growing practices will continue, Bhowmik said. Plans to test the market for organic hemp are also under way.

"Through this research, we will be able to provide a strong database for farmers interested in adopting this promising crop," he said. "We will get there soon."

GROWING ENTREPRENEURS

KATHLEEN LIANG, PH.D., IS HELPING SMALL FARMERS EXPLORE NEW OPPORTUNITIES AND FINDING WAYS TO REDUCE FOOD INSECURITY.

Connie Locklear and Kathleen Liang, Ph.D., share a laugh while going over a balance sheet at the Locklear farm.

Farming is in Millard Locklear's blood.

The Robeson County land he grows vegetables on has been in his family for generations.

He grew up helping his father. Even as he built a career managing construction projects for a Fortune 500 company, he returned to the farm when he could to lend a hand.

But knowing how to harvest vegetables or repair equipment isn't the same as knowing how to turn a small farm into a profitable, sustainable business. So, when Locklear retired and took up farming full time, he knew he faced a knowledge gap.

"My daddy's knowledge of what your yield is and what you should be getting out of an acre of land never was demonstrated to me," he said.

To ensure his success, Locklear needed to learn the business of farming. He took classes and sought advice.

That's how he met Chyi-Lyi (Kathleen) Liang, Ph.D., the W.K. Kellogg Distinguished Professor of Sustainable Agriculture and co-director of the Center for Environmental

Re:information diang@ncat.edu

Farming Systems. The center is a partnership of N.C. A&T, N.C. State University and the N.C. Department of Agriculture and Consumer Services.

"She explained to me that nobody really does know their true costs," Locklear said, recalling the farm business education he got from Liang.

As he started to record his numbers – costs, as well as how much produce he harvested for each acre he cultivated – his perspective changed.

"It made you look at farming a whole lot differently," he said.

Liang is more than just a researcher and teacher. She's passionate about helping farmers build sustainable businesses, often visiting them at their farms, poring over spreadsheets and reports with them, and providing tips on every aspect of running a profitable agricultural business.

"I'm one of the few scholars in the country actually dealing with the whole food system perspective, particularly to support farmers who are struggling to identify new opportunities," she said.

North Carolina's food gap

Liang has forged her career and unique expertise by focusing on the challenges and opportunities that small farmers, like Locklear, face.

Some farmers end up working full time in other careers just to support their farms and keep the land in the family. Some, upon retirement, sell their land to developers who use it for non-agricultural purposes, leading to an overall decline in farmland statewide. This decline contributes to food insecurity in the long run, as fresh, readily-avaliable produce and meat becomes less common and more expensive, and to environmental impacts as "working land" is lost to development.

In addition to the threat of lost farmland, North Carolina has other agricultural challenges.

Agriculture is the state's largest industry, with an economic impact of $87 billion each year. The state is one of the country's top producers of sweet potatoes, tobacco, poultry, Christmas trees, pork and trout. More than 17% of the state's workforce is engaged in some aspect of

Over a table of canned okra, Liang discusses record keeping with Connie and Millard Locklear. Liang helps small farmers see entrepreneurial opportunities and ways to become more profitable.

Liang and Connie Locklear sample ginger, one of the niche crops the Locklears are trying.

agriculture, and more than 8 million acres of land are used for farming.

Despite this, North Carolina has above-average food insecurity rates. Many people don't have access to affordable, healthy food because they live in so-called "food deserts," where fresh food such as produce is hard to find.

Liang is one of the principal investigators on a 3½-year, $750,000 National Science Foundation-funded research project, Dynamics of Coupled Natural and Human Systems. The purpose of the project is to better understand food deserts and how to mitigate them via environmentally sound agriculture. Four other A&T professors are participating in the project.

"People are struggling so much with health issues while we have an abundance of fresh food," Liang said. "So where is the gap?"

That gap is where Liang sees opportunities, in part because of her background growing up in Taiwan.

"My parents are both entrepreneurs," she said. "So, I was taught to think differently, look for different aspects to create new opportunities. That's just how I grew up."

After a post-Ph.D. stint working with farmers through the University of Nebraska's Panhandle Research and Extension Center in Scottsbluff, Nebraska, Liang dived into academia and the demands of research, teaching and building programs. She soon discovered that many farmers had little business training.

Agriculture is challenging enough as it is: The most powerful factor in production – the weather – is out of the farmer's control. To be successful, farmers need to be efficient and, increasingly, entrepreneurial.

"Farmers with limited resources and limited information are always challenged with identifying opportunities," Liang said. And identifying opportunities is fundamental to entrepreneurship.

Rather than restricting entrepreneurship to a traditional business environment, Liang said, we should ask, "How do we help farmers be entrepreneurs?"

That became the focus of much of Liang's research, teaching, and hands-on work with farmers.

Niche markets, big opportunities

Arriving in Greensboro in 2016, Liang got an early indication that the town and A&T had something special going for them when she discovered a large Asian market.

"I was amazed by the scale of Asian vegetables they have in there," she said. In her previous role at the University of Vermont, getting

Stephanie Frisbee added flowers to her brother's cattle, hay and soybean operation. Selling nonfood items is another way for farms to profit from diversification.

Asian vegetables had meant driving to Montreal or Massachusetts.

Finding the market was a reminder of the opportunities for local farmers to connect with local markets and restaurants to sell what they grow at good prices.

Much of Liang's work has been focused on helping farmers connect to these local buyers, as well as figuring out what legal agreements, relationships and production changes farmers need so that they can sell successfully to these businesses.

"I connect them with their local restaurants – Chinese restaurants, Vietnamese restaurants, Thai restaurants – you name it," she said. "It's a demand-driven model."

The new paradigm of supporting a sustainable food network has shifted from focusing heavily on supporting production to understanding demand behavior for farmers working to figure out what potential customers might buy at profitable prices.

Locklear, for example, has built his business growing organic vegetables, including Asian eggplant, Sungold tomatoes, okra and various greens – mostly heirloom varieties. In September, he was preparing to plant some Native American vegetables in response to a request from a restaurant.

These are all products that likely won't show up in a big box store's grocery section. These less common varieties can command higher prices from chefs at high-end restaurants and other picky buyers – and that means more revenue and higher potential profits for farmers like Locklear.

Local food, local farmers

Liang sees a strong connection between farm entrepreneurship and the "local food" movement. Consumer interest in buying locally grown, healthy food creates opportunities for farmers – if they recognize them and if they can connect to networks required to get food from fields and greenhouses into home and restaurant kitchens.

"The opportunity identification is a gap, as nobody told the farmers, 'Oh, these people in this community want to buy this type of stuff. Can you grow some?'" she said.

But connecting farmers to consumers – in food deserts and elsewhere – requires transportation, brokers, processors and others. Together, they

form a food network.

"The network takes the connection into consideration, how to build a relationship," Liang said. "How do you trust the people who you're buying from, where you're selling to. And how do you support each other in the transaction that creates a win-win situation without creating more burden for each other."

In addition to connecting farmers to local food networks, part of being entrepreneurial is sometimes selling nonfood products. For some farms, this might mean agritourism or "agri-tainment."

For Stephanie Frisbee and her brother, Chris Morgan, it means flowers.

A blooming business

Frisbee and her brother run a China Grove farm that's been in their family for more than 100 years. The family traditionally had raised cattle and grown hay and soybeans. In 2016, looking to diversify, Frisbee added flowers and started selling "beef and bloom" at a farmers market.

Frisbee attended a workshop at A&T where she met Liang and asked her for help with budgeting. "I was so impressed because she was, like, this little dynamo of a woman," Frisbee said.

Liang and a graduate student started helping Frisbee and her brother with budgeting and financial records, but that soon morphed into marketing advice.

"She started looking at our farmers market operations and looking at how we could be more productive," Frisbee said. "She started giving us pointers."

For example, when Liang discovered Frisbee hadn't been building an email list of her customers, "she was like, 'You don't realize how important that is,' " Frisbee said.

Frisbee's brother is disabled from an on-the-job injury when he was a diesel mechanic. The siblings were applying for a North Carolina AgrAbility grant designed to help people with disabilities remain engaged in agriculture. During a meeting, Liang Skyped in from Hawaii – where it was 4 a.m. – to explain the farm's finances to the representative.

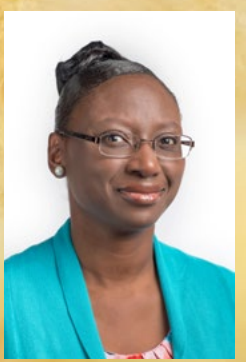
"She singlehandedly, I think, came in and saved us and made us eligible to receive this funding," Frisbee said. "That wasn't something she had to do. She's just been remarkable."

Liang works with Frisbee and Frisbee's brother, Chris Morgan, who Liang helped get a grant through N.C. AgrAbility.

Protecting Poultry

Young broiler chicks are among the poultry that can benefit from sprayed dried plasma added to their feed as a means of enhancing their immune systems and controlling salmonella infections.

Yewande Fasina, Ph.D., and her team are exploring ways to use an important healer as an alternative to antibiotics to boost flock health.



Yewande Fasina, Ph.D.

Add one more to the list of superpowers that has earned plasma the nickname "the gift of life."

A straw-colored liquid found in blood, plasma can be donated to help heal those suffering from burns, shock and trauma. Its proteins and antibodies are used to create therapies for rare conditions such as autoimmune disorders and hemophilia. And now, in addition to all that, plasma might be what helps reduce poultry disease pathogens.

Based on a review conducted by Yewande O. Fasina, Ph.D., a researcher and assistant professor in the Department of Animal Sciences, adding sprayed dried plasma (SDP) to feed has been proven to enhance gut health and disease resistance in various animal species. The finding gives the poultry industry the documentation it needs to investigate SDP as an alternative to antibiotics in controlling intestinal pathogens.

Poultry, including chicken, turkey, duck, geese, quail and pheasants, is this country's leading source of dietary protein, with an average of 93.5 pounds per person consumed annually. In fact, the United States is the world's largest

producer of poultry meat and is a major egg producer, generating about $65 billion wholesale and employing 1.2 million people. North Carolina is one of the country's top five poultry-producing states.

An ongoing challenge to the consumption of animal food products, including poultry, is the incidence of human foodborne illnesses. Annually, these illnesses affect about 48 million people, 128,000 of whom have to be hospitalized. Of the top five microorganisms implicated in foodborne illnesses, three of them – Salmonella spp., Clostridium perfringens and Campylobacter spp. – are closely linked to poultry.

For years, the poultry industry used antibiotics to reduce foodborne pathogens. But as the public demands the reduction of antibiotic use, and farmers seek to spend less to keep birds healthy and to deliver safe products to the market, the industry is searching for alternative methods.

Possibilities of plasma

That's where Fasina's research comes in. Early on, Fasina realized that plasma contains immunoglobulins (antibodies) that can bind to pathogens, such as bacteria and viruses, and help destroy them. Plasma also contains biologically active peptides and is easily digested. Dried plasma has been used extensively in the diets of piglets and in research with fish, pets, other laboratory animals and ruminants such as cattle.

Published studies from swine research showed that dried plasma used during periods of high stress, particularly during the first weeks after weaning, tended to combat enteric infections, enhance intestinal development and improve health and growth.

Since SDP is a fairly new biogenic to the poultry industry, Fasina hypothesized that plasma might also be effective in enhancing the immune system and growth of poultry during the first three weeks of life – a stressful period during which the bird's digestive and immune

Fasina, left, leads her team as they perform some tests to investigate the antibacterial activity of ginger extract on salmonella typhimurium. They are, from left, undergraduate research assistant Joseph Richardson; Temitayo Obania, Ph.D., research associate; and undergraduate research assistants Sierra Muzquiz, Quontaza Bowden and Caitlin Moore.

systems are not fully developed.

In her A&T lab, working with funding from the USDA's National Institutes of Food and Agriculture, Fasina obtained blood plasma from swine, a better source than chickens because swine have more blood. To produce the dried plasma, blood is briefly exposed to high temperatures, a process that evaporates excess water while preserving most of the biological properties. The resulting powder can be used in its dried form or as a slurry produced by adding water.

Fasina and her team of undergraduate and graduate students incorporated SDP at concentrations up to 4% of broiler chick diets and evaluated their growth performance and several other indicators of intestinal development.

Similar to results obtained from studies with other animals, Fasina's team found that adding SDP at a 3% level of broiler chicks' diet was optimal for enhancing flock growth and immunocompetence. This means lower flock mortality, faster weight gain, larger breast meat and more money for the broiler producers.

But the second phase of Fasina's research, and perhaps the most important finding, is that the SDP "significantly reduced" the intestinal colonization of Salmonella spp. in the broiler chickens when compared to the broilers in the control group.

The experiments were conducted at A&T's recently established biosecurity level 2 (BSL2) bird room in the Poultry Research Unit and in Fasina's BSL2 laboratory.

"I can say with confidence that SDP was effective," said Fasina, who shared her findings at a poultry science conference last summer in Montreal. "We documented that plasma reduced intestinal colonization by multidrug-resistant strains of Salmonella in broiler chickens."

Fasina is increasing documentation of her findings by submitting articles to research journals. She knows that this information will provide alternative methods to help poultry producers deliver high-quality birds to the market, without overusing antibiotics.

Not satisfied with just the results from SDP, Fasina wondered if there were other alternative feed additives that might reduce disease and promote growth in birds.

"I was interested in looking at what might be a readily available alternative for a farmer, particularly a small farmer," she said. "What food waste products might be used for disease control and growth promotion in poultry?"

A microplate's wells show ginger's antibacterial activity on salmonella typhimurium. The lighter the color, the more effective the extract. At right, are salmonella colonies isolated from the intestines of chicks not given sprayed dried plasma.

Growing solutions

With that question in mind, she is investigating onion skins and ginger. Both, she said, are crops with waste material that can be used as a food additive for the birds. Because feed is one of farmers' biggest expenses, finding effective but cheap additives that control disease will increase profits.

But why onion skins and ginger?

Onion, one of the oldest cultivated vegetables, is a herbaceous plant known to have anti-inflammatory properties and to reduce serum cholesterol in humans by reducing the platelets in blood that can cause heart attacks and strokes.

Both onion and ginger have antibacterial properties that are effective in treating infections, especially those related to digestion. A number of international studies also have shown that ginger has reduced Salmonella infections, particularly in parts of the world with low environmental hygiene.

This is Fasina's next work.

"I will continue to look for alternative antimicrobial feed additives to mitigate enteric pathogen colonization in broiler chickens," she said.

In addition to contributing to the body of work surrounding SDP and its use with poultry, Fasina is busy preparing the next generation of poultry scientists. Her students at A&T are an integral part of her research portfolio. Since joining A&T, she has trained two graduate students and six undergraduates. She also trained five high school students who participated in the annual summer research apprenticeship program (RAP) hosted by A&T's College of Agriculture and Environmental Sciences.

Fasina also is the founding advisor to A&T's Poultry Science Club. Members of the club participate in various poultry-related activities, including working in concert with counterparts at N.C. State University during the State Fair. Club members also participate in the College Student Career Program

Fasina and her undergraduate research assistant Quontaza Bowden check samples. Fasina's work with students has resulted in successful internship and job placements for many.

A chick takes a peck at feed infused with sprayed dried plasma.

sponsored by the USPOULTRY Foundation during the annual International Production and Processing Expo held in Atlanta.

This program has resulted in a number of students getting summer internships and job offers with the poultry industry. Fasina's graduate and undergraduate students also have attended national poultry- and agriculture-based meetings where they have made oral and poster presentations.

"One of my goals here is to help students become aware of the job opportunities available in the poultry and animal health industries," she said. "I want to help train the younger generation, and feed them something, so that when they leave here they are ready to fly.

"I often tell my students that I wasn't born here and I don't speak with your accent, but I choose to care about all people as long as they are willing to learn."

Fasina herself started learning about chickens at an early age. Her love for poultry began when she did morning chores that included caring for her family's small poultry flock in Nigeria. She was inspired to follow in the footsteps of her mother, who was an agricultural scientist.

Fasina arrived at A&T in 2015 after getting her master's degree and Ph.D. in animal science, with concentrations in poultry nutrition and feed science, from the University of Saskatchewan, in collaboration with the N.C. State Prestage Department of Poultry Science. She was a postdoctoral fellow in gut health and poultry immunonutrition at Auburn University, followed by professional stints at the same institution and at Alabama State University.

She has authored 29 articles relating to poultry and feed additives, and her work has been cited almost 200 times since 2014.

All this work with chickens, you might think she'd shun the bird when it comes time to eat. Not so.

"I love chickens," she said. "I want them cared for properly, but I also eat them. I think that's the way God designed it."

Better Bran, Better Bread

From his food engineering lab at the Center for Excellence in Post-Harvest Technologies (CEPHT), Guibing Chen, Ph.D., is on a quest to improve the nutrition and quality of high-fiber bread and baked goods.

Re: information gchen@ncat.edu

It isn't uncommon for visitors to Guibing Chen, Ph.D.'s food engineering lab to be greeted by the appetizing aroma of baking bread. It's a humble, homey scent and makes an odd contrast to the shiny beakers and the bustle of white-coated lab assistants.

But it's all in a day's work for Chen and his team. They are intent on finding new ways to enhance bread and baked goods that not only yield terrific taste and texture, but improve human health into the bargain. Chen's main focus is on processing bran fiber to make it more palatable, nutritious and easy to incorporate into baked products, without affecting taste or shelf life. The process could add value to food industry products.

On this day in early September, Ph.D. student Yun Wu is comparing a standard-recipe loaf of white bread with one that has been enriched with 20% corn bran. As he lifts the loaves from the bread baking machines, Wu explains he is gathering data on how adjustments to the amount of water and bran affect bread quality. He examines the 20% bran loaf, which lacks the uniform loft of the other, and shrugs.

"It could be better," he says.

And how does it taste? That remains to be seen. Although the recipes tested here use edible ingredients, the lab is not certified for food production or sensory testing. Each bread making

machine sports a label in bold black type reading "Not for Human Consumption." Still, much can be learned with instruments that measure density, texture, nutrition and other properties. Sensory testing by humans will have to wait until it can be conducted in an approved setting.

Wu is just one of several Ph.D. students Chen advises. Another of his students, Maria Ortiz de Erive, was a finalist in the graduate student research paper poster competition at the 2018 Institute of Food Technologists' annual meeting, recognizing her research on high-fiber bread. The secret to her success was adjusting the water content and using a special process for corn bran that Chen is developing.

Why research bran?

There are good reasons for Chen's focus on cereal bran. Not only is it an optimal source of fiber, but it also contains much of the nutrition found in grains. Fiber is something nutritionists say most of us need more of, but few of us consume as much as we should.

According to the Institute of Medicine, women are advised to get 25 grams of dietary fiber per day, a little over 8 teaspoons. For men, it's 38 grams, about 12 teaspoons.

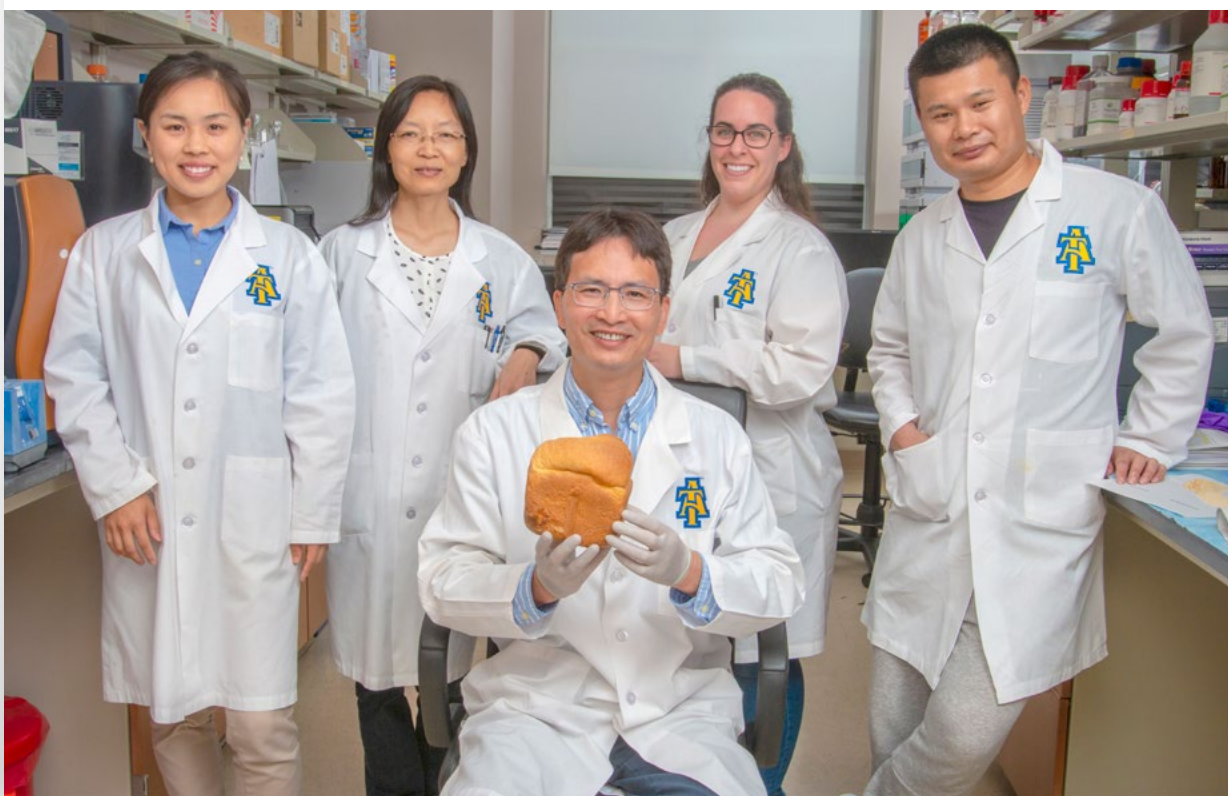
Considering that a cup of cooked brown rice or a medium apple each contains only about 4 or 5 grams of fiber, it's easy to see why many of us eating the standard American diet have trouble getting the recommended amount.

Then there's the fact that bran fiber poses a challenge for the food industry. Bran makes baked goods heavy, dense and gritty. It also turns rancid quickly, imparting "off" flavors and shortening shelf life. All of which are turn-offs for consumers and producers alike. And that's why most baked goods are made from white flour, which has been milled to remove the outer bran layer.

White flour performs well in recipes, is shelf stable, and is popular for its mild taste and smooth texture. Unfortunately, white flour also is implicated in diabetes and obesity. It's mostly starch and has a high glycemic index, causing blood sugar to spike.

Bran happens be the component in grains where micronutrients reside. It's packed with

Guibing Chen, Ph.D., and his team are testing wheat, oat and corn bran, putting each through a process to unlock its benefits. They are, from left, Fuli (Tracey) He, laboratory manager; Tao Wang, Ph.D., research scientist; Chen; Maria Ortiz de Erive, Ph.D., graduate and research assistant; and Yun Wu, Ph.D., student.



Microfluidization is a process more common to medical research than food science, but it has shown promise in improving cereal bran's palatability, shelf life and health-related properties.

most of the vitamins, minerals, antioxidants and disease-fighting phytochemicals that exist in grain. It also has physical properties that make for good digestion. Everyone agrees it's a shame all that goodness gets subtracted from flour, but when it comes to consumer satisfaction, fluffy and soft usually win out over heavy, dense and gritty.

Mindful of bran's healthful properties, the food industry has grappled with ways to process it so that it can pass muster with consumers. They treat it with enzymes, or pulverize it with mills or grinders, or compensate for bran's heaviness by adding more gluten or gums to recipes, all with varying degrees of success.

Several years ago, Chen got interested in the quandary and wondered, what if there was an even better way to process bran? Could bran be made virtually undetectable to consumers and more healthful, while also performing well in recipes and lasting longer on the shelf without the need for additives?

The search for that synergy inspired his research, and he turned for an answer to an unconventional technology: microfluidization. It's a technology more common to medical and nanotechnology research and rarely used in food engineering. Chen is pioneering this application.

Engineering bran

Microfluidization works by forcing a liquid stream containing solid particles or liquid droplets at high pressures through minute tubules with diameters similar to human hair. The extraordinary shear force breaks down the particles into micro- or even nanoparticles and changes the structure of materials of which the solid particles are made.

Chen used this technology on bran, finding that it loosened its structure and unlocked more of its nutrition. He extracted and analyzed the nutrient concentration, comparing it to that of unprocessed bran.

As expected, nutrients and antioxidants were significantly higher in the processed version. This was most likely due to the increased porosity and surface area of the particles, he said. Chen thinks the nutrients' porosity should make them more bioavailable during digestion, and he plans to test that hypothesis in future studies. The higher concentration of antioxidants also might increase shelf life, considering they may slow down lipid oxidation, he said.

Along his research path, Chen also developed an answer to another issue inherent in commercializing microfluidized bran: the high amount of water it takes to force the material through

ABOVE: Research assistant Maria Ortiz de Erive, Ph.D., examines some freshly baked loaves in the lab. BELOW: Doctoral student Yun Wu employs a texture analyzer on one of the slices of microfluidized corn bran bread. The equipment measures the textural qualities of the bread, such as hardness, springiness and chewiness.

the machine. A potentially expensive next step would be needed to reduce the moisture and get the right concentration. To solve the problem, he engineered a process for up to 20% bran in water, which yields a product that is ready to use in recipes.

"You could use it directly, with no dewatering," Chen said, adding that the process easily could be scaled up for commercial applications, since some microfluidization machines can process hundreds of pounds of material an hour.

He has done similar microfluidization research with wheat and oat bran. Corn bran, which comes from the largest grain crop in the United States, was the logical next step. The research has potential to produce new products to improve human health.

Future steps

Chen's published research demonstrates the threefold mission of CEPHT: to educate future food scientists, improve nutrition for consumers, and spur economic growth through value-added products and processes.

He said more avenues of research into processed bran will be explored as funds become available. He wants his next project to examine the role of bran in the microbiome, the ecosystem of bacteria in the human gut that plays an important role in overall health. He also hopes to conduct sensory testing and, finally, an economic analysis.

"We want to make a more powerful bread, with more bran, so you can eat the same amount but get more health benefits," Chen said.

"You could get half your daily requirement in about 5 ounces of bread. Three or four slices. It isn't hard to eat 5 ounces."

Lowering the fat in deep-fried meats

Reza Tahergorabi, Ph.D., is working to develop a protein coating to make fried food's crunch less nutritionally costly.

Deep-fat frying gives chicken and fish filets a golden brown color and a hard-to-resist crunch. It also dramatically increases the fat content of these otherwise lean meats.

Fried foods are one of the culprits in the American obesity epidemic. Obesity rates recently climbed to 39.8% of adults and 18.5% of youth, according to the National Center for Health Statistics.

Obesity comes on a tray full of unsavory sides. Obese people are at higher risk of heart disease, Type 2 diabetes, certain cancers and other health problems. More than 600,000 people die of heart disease in the United States every year.

"Since 1921, cardiovascular disease has been the No. 1 killer in the United States," said Reza Tahergorabi, Ph.D., an associate professor of food science. "We have not solved it yet. Part of the reason is because people don't want to change their diet."

If people won't change what they eat, maybe there's a way to make those favorite foods healthier, Tahergorabi thought. He and his graduate students are trying to find a way to keep the crunch and cut the fat.

In a lab on the first floor of Carver Hall, they're creating and testing edible protein-based coatings as a way to seal in moisture and block fat absorption during frying. The coatings are made from readily available material – protein recovered from byproducts of processing the meat.

The research team made protein-based solutions of 5, 10 and 15% protein. They applied the protein recovered from fish to the fish fillets and the protein recovered from chicken to chicken pieces. The meats then were battered, breaded and fried.

For the meats coated with a 15%

Re:information
rtahergo@ncat.edu

Tahergorabi, right, and graduate student Sam Adegoke examine a test tube of the protein mixture used to coat food samples before frying.

solution, fat absorption was reduced by 85% in fish and up to 75% in chicken. Additional testing with both lab equipment and human testers found that the coating did not hurt the appearance, flavor or texture of the meats. If the researchers can consistently produce healthier fried foods, this process could be a potent new weapon in the fight against obesity.

Protein power

Understanding how the coatings work requires understanding how frying works. The problem with frying chicken and fish in the traditional way is that dunking the meat in hot oil causes its moisture to vaporize. The water that escapes is replaced by oil, causing the fat content of the meat to skyrocket. In some experiments conducted by other researchers, the fat content of fish was 100 times greater after frying than it was before, Tahergorabi said.

"The oil acts as a medium for heating, and at the same time the oil is absorbed into food when you fry it," he said.

The protein coatings developed in Tahergorabi's lab prevented moisture loss during frying, and thereby reduced fat absorption. The coating essentially acts as a fat blocker.

"When you are frying, there are pores developing in the chicken," said Daniel Ananey-Obiri, a graduate student who worked with Tahergorabi on the research. "An edible coating blocks the pores and prevents the oil from entering the chicken. It sets up a barrier to fat absorption."

Ananey-Obiri came to A&T from Ghana, completed his master's degree in food and nutritional science and has started a Ph.D. in computational science engineering, also at A&T.

In addition to the potential health benefits, the use of byproducts as coatings is good for the environment. Using byproducts in frying reduces the need for their transportation and disposal. When a fish is filleted, as much as 70% of it can become waste.

The coatings are made from readily available material. Processing chicken and fish results in lots of high protein byproducts, like skin and meat left on the bones. The researchers have extracted the proteins through a process known as isoelectric solubilization and precipitation. Tahergorabi, an A&T faculty member since 2013, began using ISP when he was working on his Ph.D. at West Virginia University.

The first step is to grind the byproducts

and add water. Add a base, such as sodium hydroxide, to increase the pH, and the proteins unfold and dissolve in the water. When spun in a centrifuge at 10,000 revolutions per minute, the protein and water form a distinct layer in the test tube.

The protein solution is extracted, then an acid is applied to reduce the pH and to weaken the bonds between the water and the protein. Another spin in the centrifuge separates the protein from the water. The researchers are left with pure protein, in this case a white paste with the consistency of peanut butter.

Natural fat blockers

Some consumers may be reluctant at first to eat a coating derived from byproducts, Tahergorabi acknowledged, but the public has been won over before. He points out that some initially refused to eat foods that had been irradiated, but that practice is now commonplace.

Researchers at other institutions are exploring different sources for edible coatings, such as proteins from whey and soy, but those trigger allergies in some people. Tahergorabi's process avoids this issue by using protein from the same food to which the coating will be applied.

Tahergorabi and his team are examining other modifications to the frying process that could provide additional health benefits. One is replacing the corn starch used in batter with sweet potato starch. His early results show that the sweet potato starch decreases water loss and fat uptake in fried foods.

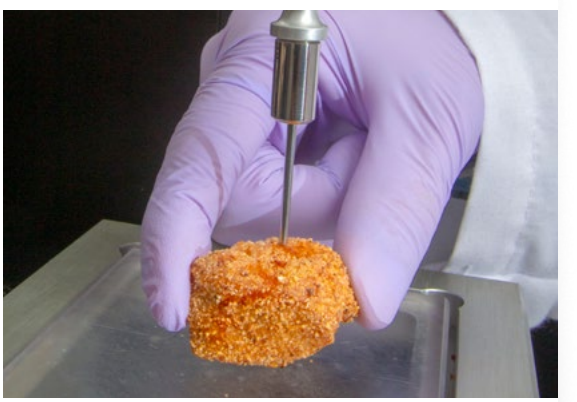
He and his graduate students also are looking at other natural ingredients that could have health benefits when incorporated into the preparation of meats for frying. One such ingredient is quercetin, a compound contained in onion peels – another frequently discarded byproduct. Quercetin has shown potential as having antibacterial, antioxidant and anti-obesity properties.

They also may investigate how the type of oil used for frying affects fat uptake during frying. Popular choices for restaurants and home cooks include peanut oil and canola oil, based on factors such as smoke point and flavor transfer.

One of Tahergorabi's graduate students, Sam Adegoke from Nigeria, enrolled in the food and nutritional science master's program at A&T in August. Adegoke is excited to be working with Tahergorabi and is looking forward to making a global impact.

"Fat uptake and the consumption of fat is a problem across the world, not just in the U.S.," Adegoke said. "This research could allow us to have the foods we love to eat in a healthier presentation. The potential is big."

A chicken sample is dipped in protein coating before being rolled in breading. At bottom, a puncture test is used to evaluate the textural quality of the reduced fat fried chicken.



UNDERGRADUATE RESEARCH SCHOLARS PROGRAM

The Agricultural Research Program provides opportunities for students in the College of Agriculture and Environmental Sciences to develop advanced scientific skills.

Danielle Chasten: Advancing food science to improve wellness

Danielle Chasten likes to cook in her free time.

"Cooking allows me to be creative and indulge," the senior said.

But at N.C. A&T she has learned that food has another benefit: It can be good medicine.

"You can prevent and treat disease by eating nutrient-dense foods," she said. "Food also plays a critical role in helping us to stay healthy as we age."

When it came time to choose a major, Chasten gravitated to the food and nutritional science program in the Department of Family and Consumer Sciences.

"I want to advance the science of food," she said. "I want to contribute to people everywhere being healthier."

Chasten joined the research lab of Salam Ibrahim, Ph.D., as a junior, having distinguished herself in one of his classes.

"Danielle is an excellent student," said Ibrahim, a food and nutritional sciences professor. "The project she worked on in our lab was basically her project from start to finish. She researched the topic and then designed an experiment, optimized it – basically developed the whole thing. I was very proud of her."

As a result of Chasten's performance in the research lab, Ibrahim encouraged her to apply to the Undergraduate Research Scholars Program, and she was accepted. Like all students in the program, Chasten was tasked with steering an original research project from concept to completion.

"I learned that so many little things go into making the project work," she said. "Something as simple as the temperature in the room not being right can mess it up, and a lot of work is wasted."

For the project, Chasten, along with Ibrahim and senior research assistant Tahl Zimmerman, Ph.D., have collaborated with researchers at Wake Forest University to develop a screening system for the enzyme choline kinase, which is necessary for the growth of the bacteria streptococcus pneumoniae (S. pneumoniae). This strain of "strep" is the same bacteria that causes ear infections, sinusitis, even meningitis.

Danielle Chasten has worked out a screening system for an enzyme known to factor into strep bacteria's growth.

The choline kinase enzyme turns choline – a nutrient necessary for the growth of many living things, from humans to bacteria – into another metabolite called phosphocholine, a building block for cell walls. Without phosphocholine, bacteria will die because they cannot build cell walls. A good strategy for preventing the growth and spread of the strep bacteria, then, is to design a drug that prevents choline kinase from producing phosphocholine.

"If you stop choline kinase from growing, the strep bacteria won't grow, either," Chasten said. "That could have important implications for health care providers who want to prevent strep."

First, Chasten had to develop a system for measuring choline kinase's activity by figuring out how fast the enzyme produced phosphocholine. Then, she worked to find the proper concentration of inhibitor – a molecule that binds to an enzyme and halts its function – to pair with the enzyme. To do this, she and the team tested two different-acting drugs, which she and Zimmerman thought might inactivate the enzyme.

Salam Ibrahim, Ph.D.

"Over a year of very hard work and perseverance, Danielle figured out a way to measure choline kinase's activity and to screen drugs to inactivate it," Zimmerman said. "She also worked out how the drugs did what they did."

Chasten's hard work led to a publication, now under review, and several conference presentations.

But her work wasn't over.

"Then, we asked ourselves, can we do the same thing naturally?" she said. Natural remedies are more readily available to more people, and less potentially toxic, than chemical inhibitors.

To answer this question, the experiment has moved into a second phase, testing natural and microbial extracts' ability to affect the choline kinase enzyme. Chasten's experiments have continued this semester.

After her graduation in December, Chasten's path will take her to graduate school. Ultimately, she would like to work in food product development, manufacturing nutrient-dense, healthy food products.

"I want to help society," she said. "What I've enjoyed most about this project is that I've accomplished something that can potentially do that."

Chasten and Ibrahim work on samples in the lab. Ultimately, she said, she plans to work in food-product development.

Asayah Barnwell: Finding her calling in the lab

Some students come to college unsure of their talents and interests.

Not Asayah Barnwell.

"I've known what I wanted since eighth grade, and that was to come to N.C. A&T and major in laboratory animal science," she said with a laugh.

Barnwell's older cousin was an Aggie computer science major who also marched in the band. The family came to campus often to attend events and cheer on the Blue and Gold Marching Machine. From that beginning, Barnwell was drawn to A&T.

"I just loved the atmosphere. I knew I wanted to come here because the people are like a family," she said. "I've always been interested in science, and I also love animals. When I saw that A&T offered a degree in animal science, I knew that this was the place for me."

As a laboratory animal science major in the Department of Animal Sciences, it didn't take long for Barnwell to find her way into a research lab and to realize that she loved that, too. Now that she is a senior, the Hertford native has discovered that, while some may find a laboratory setting boring or intimidating, she has found a calling.

Jenora Waterman, Ph. D.

"When I started taking classes that had lab requirements, I realized that I wanted to do this for a living," she said. "I just do really well in a laboratory setting. I want to go into either biomedical science or research science."

Barnwell's focus and sense of purpose had propelled her into her junior year when it happened: the toxicology exam.

The class in toxicology – the branch of science that involves the nature, effects and detection of poisons – taught by Jenora Waterman, Ph.D., is tough. But Barnwell, then a junior, dug in, taking copious notes and hanging around after class to ask questions. Her work paid off: When she went to pick up the exam, she found that she had scored 103.

Barnwell has been an assistant in Waterman's lab since her junior year.

She also had scored Waterman's notice and approval.

"That's outstanding, especially for a junior," Waterman said. "Asayah was very quiet, but she always stayed after class, and she consistently did well on all the exams. When she told me that she wanted to work in a lab, I said, 'Why don't you come work in mine?'"

Barnwell took Waterman up on her offer and began assisting with her large, ongoing research project studying the effects of pigs' environments on the incidence of inflammation and fibrosis in their airways. Waterman encouraged Barnwell, now a senior, to apply to the Undergraduate Research Scholars Program, and she was accepted.

"She's doing very well," Waterman said. "She has collected all of the necessary samples, and

she is now in the process of completing the initial round of the study. She works well with the team, follows directions well and shows good research skills."

Waterman's study compares the airways of pigs raised in a pasture to those of pigs raised in conventional indoor settings, where less-than-ideal management practices, crowding of animals and dust generated by feed can lead to conditions such as chronic airway inflammation and respiratory disease.

Waterman is studying the early onset of such conditions, seeking to make the facilities safer for both pig and farmer. Pigs' respiratory systems are very similar to ours, so studying swine can shed light on conditions experienced by the people who tend them, including chronic obstructive pulmonary disease and chronic bronchitis. A hallmark of chronic bronchitis is airway fibrosis, or scarring. It's not currently known whether pigs develop these conditions, but Waterman's research aims to answer questions in this area.

Barnwell's role in the study is to analyze genetic material obtained from the lungs and airways of pigs that have gone to market. Using the polymerase chain reaction (PCR) method to analyze RNA from the tissue cultures, Barnwell can see which genes are being expressed, or turned into proteins. Genetic expression allows researchers to analyze the subject's condition.

"The program has opened up lots of opportunities for me," said Barnwell. She recently finished a reproductive toxicology research internship as part of the Summer Undergraduate Research Experience in Toxicology program at the University of Illinois. She presented her summer internship project at the 2019 annual CAES Showcase of Excellence and won second place in the Undergraduate Research Poster Competition.

"I know how to conduct responsible research using animals, how to treat them and care for them so that the results will be valid. Being a research scholar has definitely moved me closer to my goals," she said.

When she graduates in 2020, Barnwell will add another distinction to her list: She will be her family's first college graduate.

"They're really proud," Barnwell said of her family. "They want me to do what I love, and that's research. A&T definitely taught me that."

Waterman, Barnwell and research assistant Marquis Harper are working on a project to study how pigs' environments affect their airways.

Re'Jae Holland: Learning the life skills a researcher needs

Animal sciences major Re'Jae Holland wants to be a veterinarian. But unlike some prospective vet students, who mainly want to work with household pets, the Richmond, Virginia, native is open to working with animals of all kinds.

"At a previous internship, I worked with mice. Here, it was chickens," she said.

Luckily for Holland, the research lab of Yewande Fasina, Ph.D., assistant professor in the Department of Animal Sciences, was willing to add another interested student. Holland, then a junior, had been a research intern in a program the previous summer at Virginia Tech, where she was bitten by the lab research bug.

"I like learning new things," Holland said. "I knew I wanted to stay involved with research, so when I got back to campus that fall, I asked around to see which professors might need someone."

One of those professors was Fasina.

"I said, 'You're interested in being an undergraduate research assistant? OK, let's try,'" Fasina said. "It worked out well. Re'Jae has an aptitude for research."

After Holland joined the lab, Fasina encouraged her to apply to the Undergraduate Research Scholar Program. Holland applied and was accepted.

Fasina's ongoing project involves determining the effects of different strains of salmonella bacteria on the growth and intestinal development of broiler chicks. The project has significant implications for the poultry industry, where the incidence of salmonella is high. The bacteria kill many young chicks, and older birds also can become infected or become carriers.

Yewande Fasina, Ph.D.

Humans can become infected by eating undercooked or raw chicken meat or eggs, leading to abdominal cramps, vomiting, diarrhea and flu-like symptoms. Salmonella is one of the most common causes of food poisoning in the United States.

"Industry has done a fantastic job of reducing the level of salmonella contamination at the farm level. They can do an even better job with this research," Fasina said.

Holland's role in the project was to investigate the effects of salmonella typhimurium, a strain that chickens contract easily, on chicks' growth, feeding patterns and mortality.

"In the poultry world, growth is key," Fasina said. "Producers want to optimize weight because the bigger the bird, the bigger the profit."

Holland gave the chicks oral doses of the bacteria, then weighed them weekly and recorded how much they ate. To find out if the chicks' intestinal development was affected, she performed an enzyme test to assess gut function.

RCH SCHOLARS PROGRAM

Holland worked with Yewande Fasina, Ph.D., on a project to determine the effects of salmonella bacteria on the growth and intestinal development of broiler chickens.

"If we want to tell industry, 'This is what salmonella does to your chicks,' then we need to isolate a strain from commercial flocks," Fasina said.

Ultimately, the goal is to reduce commercial poultry growers' use of antibiotics to combat salmonella, a practice that was once the industry norm but is rapidly falling out of favor.

"Antibiotic overuse isn't good for us or the birds," Holland said. "Some strains of salmonella are also becoming resistant to antibiotics. The strains need to be tested so that practice can be stopped."

Holland said that working on the project taught her not only research skills, but also life skills.

"Deadlines matter. I learned that first and foremost," Holland said. "There are so many things that can come up during a research project; you really have to be prompt with your part. I really had to pick up the pace and learn as I went so that I could make the deadlines."

Her next lessons: Teamwork is essential, and communication is key.

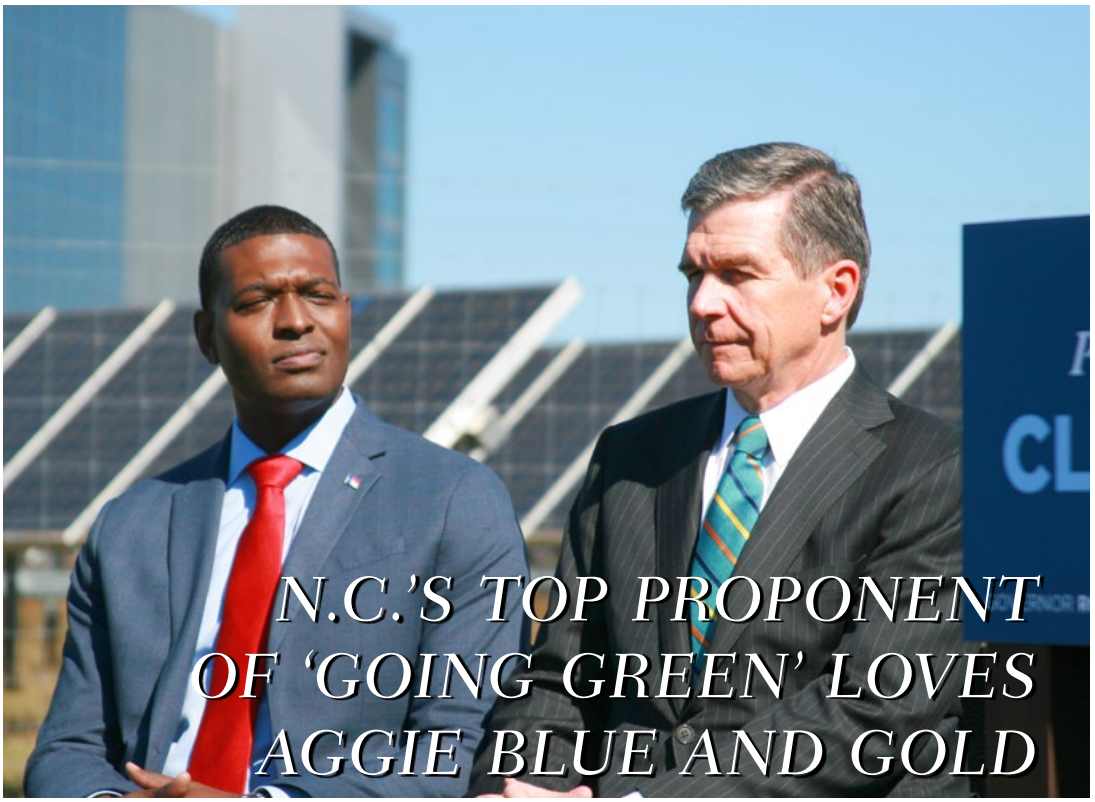
"Last semester, there were four of us on the project team. This semester, five or six of us had roles – running tests, getting data. You have to be able to collaborate and communicate, because if you're late or unclear, it can really mess the next person up and derail the whole experiment."

Holland graduated in May and has taken her research skills to Tuskegee University's College of Veterinary Medicine. She credits the URSP with helping her get there.

"The Undergraduate Research Scholars Program helped me become independent," Holland said. "I knew I liked research, but now I know that I can understand and do more on my own than I could before."

"She picks up information quickly and was able to understand what we were doing with this project, which is really a master's-level project," Fasina said. "Re'Jae knows what she wants and sticks with it. I'm very proud of her for that."

Fasina, right, describes a process for Holland to duplicate.



N.C.'S TOP PROPONENT OF 'GOING GREEN' LOVES AGGIE BLUE AND GOLD

MICHAEL S. REGAN '98 HAS A CLEAN-ENERGY FOCUS AS CHIEF OF N.C.'S DEPARTMENT OF ENVIRONMENTAL QUALITY.

North Carolina has its share of nationally visible environmental issues.

Destructive, forceful hurricanes. Seeping, buried ash from coal-fired power plants. Legal battles surrounding a proposed 600-mile natural gas conduit known as the Atlantic Coast Pipeline, which is slated to have its last leg in the state.

At the same time, the state is looking for ways to create the environment of the future, setting ambitious goals for reducing greenhouse-gas emissions, increasing the number of zero-emission vehicles on the roads and reducing energy consumption in state-owned buildings.

The task of solving the environmental problems of the past and finding the way forward falls to the state's top environmental steward, the secretary of the N.C. Department of Environmental Quality. Since 2017, the position has been filled by Michael S. Regan, a 1998 graduate of the College of Agriculture and Environmental Sciences.

As secretary of the N.C. Department of Environmental Quality, N.C. A&T alumnus Michael S. Regan works closely with Gov. Roy Cooper (right) to formulate clean-energy policies for the state.

Before he was the state's top proponent of "going green," Regan was Aggie blue and gold. "A&T absolutely prepared me for this role," said Regan, whose bachelor's degree is in earth and environmental sciences from the Department of Natural Resources and Environmental Design. "It strengthened my understanding of who I am and what I can do for society."

Appointed by Gov. Roy Cooper, Regan oversees a program of science-based environmental stewardship that seeks to work with the business community, not against it.

"My role is to get people to see the win-win," he said. "We can't just legislate our way out of these situations, we have to get business to work with us and adopt a big-picture model to take care of the environment and our communities."

Business and government partnerships, Regan said, are the best way to grow infrastructure in sustainable ways that protect air and water quality, bring assets to rural areas, and give a voice to underserved populations who have not always been treated sensitively by economic growth and infrastructure projects.

"We have to nurture a globally competitive economy at the same time that we protect the environment and public health," he said. "One way to do this is to develop these partnerships."

Environmental advocate

A native of Goldsboro, Regan became interested in the environment growing up, hunting and fishing in Bladen County with his grandfather and his father, who also is an Aggie.

"I always enjoyed the outdoors growing up," Regan said. "I also had some allergies and characteristics of asthma, which could be exacerbated by high-ozone days, so I learned pretty quickly about the connection between the environment and people's quality of life."

After coming to A&T as a biology major, he felt drawn to Earth and environmental science as an academic extension of his interest in the outdoors. The welcoming environment on the HBCU campus was a pleasant surprise, too.

"A&T was a cultural awakening for me," he said. "I really enjoyed the rich history, the notable alumni, the lessons about cultural heritage. The professors all seemed personally invested in helping students thrive. I felt understood."

Godfrey Uzochukwu, Ph.D., director of the Waste Management Institute, soon emerged as a mentor.

"I spent a lot of time with Dr. Uzo, setting up the Waste Management Institute," Regan said. "He really pushed me."

After graduation, Regan took an internship with the Environmental Protection Agency in North Carolina. The internship led to a full-time position. Regan spent the next eight years with the EPA, eventually serving as a national program manager responsible for designing programs aimed at reducing pollution and improving energy efficiency and air quality.

Regan left the EPA to join the nonprofit Environmental Defense Fund, an advocacy group known for its work on global warming, ecosystem restoration, ocean health and human health, all with a science-based, business-informed approach. As associate vice president for U.S. climate and energy, and the nonprofit's Southeast regional director, Regan led the group's efforts to reduce the impacts of climate change and air pollution.

He left the EDF with the intention of starting a unique consulting company,

M. Regan and Associates, LLC, designed to focus on bringing clean-energy resources to rural communities.

"My goal was to engage with state agencies, such as the Department of Commerce, and with energy providers, to show them how clean energy could be used to improve rural communities and give them the same benefits that urban centers have," he said.

North Carolina is primarily rural; 80 of the state's 100 counties fit the category in terms of population density, according to the N.C. Rural Center. These smaller communities often lack the infrastructure needed to promote growth and improve residents' quality of life.

"In urban areas, there's a constant effort to use the electric grid more efficiently; in rural areas, not so much," Regan said. "If the rural areas have access to clean energy, then they can recruit business, which would in turn develop the infrastructure that they need – a hospital, for example."

An agenda for clean energy

Regan's plans took a turn when he met Roy Cooper at a fundraiser in 2016, while Cooper was on the campaign trail for governor.

"I was inspired by his clean energy vision," Regan said. "So I shared my resume with his team."

Cooper appointed Regan as environmental quality secretary after the 2017 election. Immediately, the agency was tasked with enacting an ambitious agenda.

High on the list was water quality.

In addition to coal ash, emerging perfluorinated compounds called per- and polyfluoroalkyl substances (PFASs) are among the manufacturing byproducts that contaminate public water supplies. Some of these chemical compounds have been linked to health problems, including forms of cancer; others require further study.

"We need to figure out the appropriate level of protection for the public health while also keeping manufacturing competitive," he said.

In October 2018, Gov. Cooper issued an executive order to address climate change and transition to a clean-energy economy. The plan, developed by the Department of Environmental Quality, lays out an ambitious series of goals for the state to achieve by 2025. Executive Order 80 calls for a statewide reduction in greenhouse-gas emissions to well below 2005 levels; a reduction in energy consumption in state-owned buildings to 40% below 2003 levels; and an increase in the number of zero-emission vehicles to 80,000.

"Business has an interest in sustainable energy, particularly in recruiting and retaining younger workers, who demand that business pay attention to these things," Regan said. "As technology evolves, it becomes easier for them to comply with environmental rules, and the market expands."

One of the key components of Executive Order 80 is the Clean Energy Plan, which charts a path for the state to improve its energy grid and add clean sources of energy production. Improving infrastructure, such as building electric-vehicle

ABOVE: Secretary Regan stands outside DEQ headquarters, one of the buildings in Raleigh's "Green Square." Completed in 2012, the two-block redevelopment project has earned the nation's highest building standard in environmental design. The four-story globe at right houses a multimedia theater.

LEFT INSET: Secretary Regan and Gov. Cooper take reporters' questions about the governor's executive order on climate change.

charging ports, is included in the plan. Public comment on the plan has been positive; a final version of the plan is set to be released this fall.

As industries expand, Regan said, the effect on some communities – especially economically disadvantaged and minority areas – can be disproportionately negative. The 16-member Secretary's Environmental Justice and Equity Board, the state's first board to advise on environmental impacts in various communities, was established last year to provide public feedback and oversight for the department's processes.

"Many people think of clean air and water as a civil right," Regan said. "People of every socioeconomic class want to protect these things. We have to make sure that our policies are thought through so that inequities don't occur."

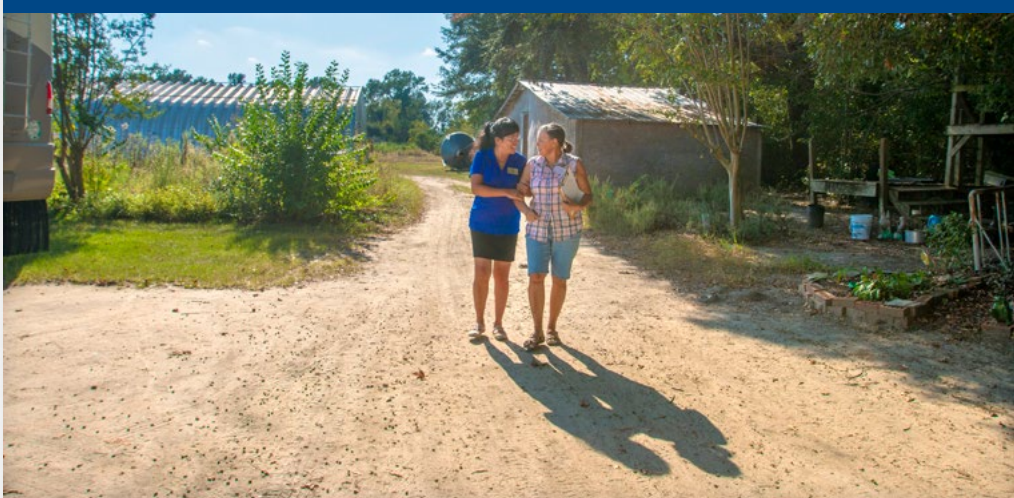
Being a part of the governor's cabinet is an honor, Regan said; one that grew out of lessons learned on A&T's campus.

"The investment that the university and the professors made in me personally helped to make me who I am today," he said. "I'm proud to be a graduate of N.C. A&T."

Nonprofit Org.
US Postage Paid
Permit No. 202
Greensboro, NC

Re:search

A MAGAZINE OF THE AGRICULTURAL RESEARCH PROGRAM IN THE COLLEGE OF AGRICULTURE AND ENVIRONMENTAL SCIENCES AT NORTH CAROLINA AGRICULTURAL AND TECHNICAL STATE UNIVERSITY



Chyi-Lyi (Kathleen) Liang, Ph.D., left, and Robeson County farmer Connie Locklear reluctantly end one of Liang's recent visits to the Locklear farm. Liang, the W.K. Kellogg Distinguished Professor of Sustainable Agriculture and co-director of the Center for Environmental Farming Systems, is passionate about helping farmers build sustainable businesses, often visiting them at their farms, poring over spreadsheets and reports with them, and providing tips on every aspect of running a profitable agricultural business.