

# ACTION IN AGROFORESTRY

monthly newsletter of The Center for Agroforestry at the University of Missouri (UMCA)

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## Mizzou Advantage Supports Collaborative Eastern Redcedar Research

**Background:** Eastern Redcedar (ERC) is one of the most widely distributed tree species in Missouri. It is often considered a “trash or nuisance” tree due to its invasiveness and low market value to the landowner. Bioactive diterpenoids isolated from ERC tissues, including berries and leaves, have shown strong antibacterial activities against a wide range of human and animal pathogenic bacteria including MRSA (Methicillin-resistant *Staphylococcus aureus*). With the support from the Mizzou Advantage program, expertise at the MU campus has been integrated with an industrial partner. Collaborations include the MU Center for Agroforestry, Department of Veterinary Pathobiology, Department of Forestry, Department of Biochemistry, Dalton Cardiovascular Research Center, Department of Physics, Bioinformatics Institute and Thar Process Inc. Interdisciplinary expertise ranges from natural product chemistry, bacterial molecular genetics, medical microbiology, analytical chemistry and structural biochemistry to bioinformatics and biophysics in order to explore the health benefits and economic opportunities of bioactive compounds isolated from ERC. The specific objectives are 1) to elucidate the novel modes of antibacterial action, and 2) to develop a cost-effective and environmentally friendly pilot-scale bioprocessing production procedure through collaboration with the industrial partner, Thar Process Inc. This project will not only provide critical information for future drug design against drug-resistant pathogens, but also provide the opportunity to turn the abundant, low value, renewable materials from the ERC into a lucrative high tech industry in Missouri. Mizzou Advantage funds are being used to:

**1) Characterize the modes of action against MRSA:** Researchers are intrigued by the efficacy of the isolated compounds against MRSA. The mode of action of the antibacterial compounds was elucidated by studying the enzymatic degradation

profiles, examining the effects of diterpenoids on polymerization of cytoskeleton cell division protein FtsZ, calculating diterpenoid-FtsZ binding kinetics using computational docking algorithms, comparing the sequence differences between induced resistant mutants and sensitive parent strain utilizing Illumina high throughput genomic sequence analysis. Three potential diterpenoids-FtsZ binding pockets were identified. So far, more than 8000 genes with 8.5 million base pairs have been processed generating 1.6 tera bytes of the genomic information. Twenty-six genes linked to the antimicrobial mode of action were identified in the MRSA resistant mutant genomic sequencing. The constructed antimicrobial mode of action provides critical information for future drug design against drug-resistant pathogens.

**2) Develop a pilot-scale production process:** A feasibility study for pilot-scale production using an environmental friendly production process, supercritical carbon dioxide extraction (SCDE) was conducted through collaboration with an industrial partner Thar Process, Inc (Pittsburgh, PA,).

Supercritical carbon dioxide extraction is a recently developed, efficient, and environmentally friendly extraction technique used to extract valuable phytochemicals from botanical raw material. This technology has been used to extract and refine bioactive compounds from botanicals for industrial scale manufacturing. There are several advantages to this extraction technology including: 1) high extraction efficiency without solvent residue, 2) significant removal of color and aroma, 3) tailor-made specifications of the product due to easy manipulation of selectivity of separation,

(cont. under Eastern Redcedar on pg. 2)

### Jack Schultz Invited to Speak at TEDxMU Event

Jack Schultz, director of the Bond Life Sciences Center and professor in the Division of Plant Sciences, delivered a presentation as part of the TEDxMU program on April 15th. His presentation was titled “Eavesdropping on Plants.”

Presentation Summary: Jack Schultz has been watching insects eat plants for four decades. Along the way he and his collaborators discovered that plants complain about being eaten and call for help. They emit unique mixtures of volatiles (odors) in response to almost any stressful situation. Schultz says there is a “conversation” going on all around us; plants are “talking” to other plants, to microbes, and to insects. He thinks that if we can learn to

listen, we can interrogate plants about their experiences. “Do you have disease?” “What has been eating you?” “How’s the soil?” “Tell me about air quality.” Schultz and colleagues are working to develop plants as sentries and reporters, with the potential to revolutionize agriculture, environmental monitoring, and even national defense. This means developing the listening devices needed for eavesdropping on nature’s conversations and interrogating plants about their lives.

A video of the presentation can be viewed online at [http://www.youtube.com/watch?v=zTQVLFg3sgM&list=P LC5BA914FFA670472&index=1&feature=plpp\\_video](http://www.youtube.com/watch?v=zTQVLFg3sgM&list=P LC5BA914FFA670472&index=1&feature=plpp_video).

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## Kudos

On April 13th, Ph.D. candidate **Kristen Veum** of the Department of Soil, Environmental and Atmospheric Sciences, under the supervision of Dr. Keith Goyne, presented her Ph.D. seminar and successfully defended her dissertation “Characterization of Soil Organic Matter Under Varying Conservation Management Practices.” Congratulations Kristen.

**Ms. Jie Gao**, master’s student in PRT under the supervision of Dr. Carla Barbieri, presented her research results at the MU Graduate Professional Council Research and Creative Arts forum on March 17th and was awarded first place in the Quantitative Social Science Category. Jie’s study is focused on the implications of consumer preferences of agroforestry landscapes for agritourism purposes. This was a collaborative project between the Center for Agroforestry Socio-Economic Cluster and the Department of Parks, Recreation & Tourism. Jie received the award the day after she successfully defended her thesis.

Former student, **Madelyn Myers**, who was sponsored by the UMCA for two and a half years on a bioremediation project with Dr. Chung-Ho Lin, was selected as one of the handful of interns chosen by Memorial Sloan-Kettering Cancer Center in New York, one of the top 2 cancer research centers in the world. She told Dr. Lin she would not have been qualified or competitive for the position without the training received from UMCA’s interdisciplinary program.

## COMING SOON...

**April 28** MNGA Chestnut Grafting Workshop  
10:00 a.m. - 11:00 a.m.  
Shifley Nut Farm  
Centralia, MO  
Call or email for more details: 573-696-0779  
or 573-424-5105; shifley@socket.net.

**April 30** Agricultural Biotechnology: Increasing Complexity - Mizzou Advantage presentation  
3:30 p.m. - 5:00 p.m.  
Memorial Union, Stotler Lounge  
University of Missouri

## Outreach

Dr. Johann Bruhn, along with Nicole Begemann, Dr. David Emerich, Monica Everett, Claire Friedrichsen, Henry Hellmuth, Dr. Mary Hendrickson, Anna Henry, Dr. Robert Kremer, Lucy McGowan, Mary Pershing, and Dr. Christopher Starbuck presented the poster “Out of the Wild: Toward Cultivating the Burgundy Black Truffle in the Central USA” at the Mizzou Advantage poster session held on April 6th at the Bond Life Sciences Center. The poster was compiled as part of a holistic undergraduate research team effort.

## Eastern Redcedar (cont. from pg. 1)

4) low risk of thermal degradation, 5) energy saving solvent regeneration, 6) nonflammable solvent without concerns about environmental hazard, 7) faster extraction process, and 8) residues can be used for further processing.

Supercritical carbon dioxide extraction has shown to be an efficient and environmentally friendly extraction technique to isolate the bioactive compounds from ERC. The Phase I feasibility study has recently been successfully completed with 10 extraction cycles of 500g of ERC leaf or berry materials. The extraction efficiency of SCDE procedure was found to be enhanced by more than one order of magnitude (290 fold) compared with that of traditional solvent extraction methods. The extraction capacity (500 grams to 1 kg) yields enough quantity to explore the novel bioactive tricyclic diterpenoids for detailed structural characterization and biochemical studies.

## UMCA Facilitates Transfer of Research to the “Real World”

Elemental Enzymes Inc., a spin-off of collaborative work between Chung-Ho Lin, George Stewart and Brian Thompson, has recently received a number of awards. Recognition includes: 1st Place, TechLaunch Program at the Missouri Technology Corporation; Missouri Dept. of Economics Development Small Business Program; 2011 Rising Star of Innovation and Entrepreneurship Award by the Missouri Small Business Development Center; State Wal-Mart business plan competition; Regional Wal-Mart business plan competition; invited to National Wal-Mart business plan competition; and has been chosen to represent MU for the Rice International Business Plan Competition (chosen as one of final 42 teams among 1400 international competitors, <http://rbpc.rice.edu/Teams/>).



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 The Center for Agroforestry  
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