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UNIVERSITY OF MISSOURI, COLUMBIA

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Durable
A DEVICE TO MEASURE PUPILLARY LIGHT REFLEX IN INFANTS AND TODDLER

This invention provides a technology to measure reliably the pupillary light reflex (PLR) in young children. PLR is a simple noninvasive neurological test that can monitor the neurodevelopmental progress in children.

American Academy of Pediatrics estimates that at least 12% children are born with a neurodevelopmental disability that will require medical, educational and special services remediation. Early therapeutic intervention is the only available treatment and has been clinically proven effective in improving these children outcome. However, early identification of neurodevelopmental disorders has been challenging. Current practice relies on parent reporting and behavioral observation that suffers poor accuracy and sensitivity.

Therefore there is a clinical need for an objective measure biomarker that can track normal neurodevelopmental progress in infants and toddlers. Pupillary light reflex (PLR) is an objective functional neurological test that measures the pupil size changes in response to a short light flash. Our recent studies have suggested that PLR has the potential to meet this aforementioned clinical need.

Unfortunately existing PLR instrumentation cannot be reliably used in young children. This invention provides a solution that can accommodate the test subject’s head movement during the PLR test and thus can measure PLR easily in young children.

**Potential Areas of Application:** Effectively measure PLR in young children
**Patent Status:** Provisional filed 3/22/12
**Inventor(s):** Gang Yao and Judith H. Miles
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PRODUCTION OF BIOCOMPATIBLE GOLD NANOPARTICLES FROM HERBS, PLANTS, SEEDS AND TREE EXTRACTS

Gold nanoparticles are being used in a myriad of medical and technological applications ranging from diagnostic, therapy agents in medicine, to sensors in telecommunication/auto industry and as sources of catalysts in hydrogen production for alternative sources of energy. Therefore, the production of gold nanoparticles (and nanoparticles of other metals) through green nanotechnology routes will have tremendous implications in a number of fields.

In 2008, we discovered an unprecedented approach to Green Nanotechnology via the use of phytochemicals in Soy for the production of gold nanoparticles. This process simply involved mixing of Soy seeds, in water, with gold salt that led to the production of well-defined biocompatible gold nanoparticles (Editor’s Choice in SCIENCE, 2008). With this genesis of Green Nanotechnological approach, we have developed numerous processes recently that take advantage of redox properties of phytochemicals in Tea, Cumin, Cinnamon and plethora of herbs, plants, seeds and tree extracts—all of which have resulted in the production of gold nanoparticles through interactions of corresponding phytochemicals with gold salt in water. Our research has further probed on the importance of such green nanotechnological processes for the production of cancer specific gold nanoparticles. For example, gold nanoparticles derived from Tea has been shown to have a coating of Epigallocatechin gallate (EGCG), also known as epigallocatechin 3-gallate, the ester of epigallocatechin and gallic acid, and is a type of catechin.

EGCG is the most abundant catechin in tea and is a potent antioxidant that has well prove. therapeutic applications in the treatment of many human disorders and diseases including cancer. EGCG has an excellent affinity toward Laminin receptors that are overexpressed in hormone refractory prostate cancers. This elevator pitch presentation will provide highlights on prostate cancer receptor specificity of EGCG-gold nanoparticles (EGCG-AuNP) and their subsequent application as prostate tumor therapeutic agent. The overall oncological implications of the emerging field of green nanotechnology with specific examples of the design and development of sophisticated molecular imaging and cancer therapy agents will be presented.

MU’s process for the production of biocompatible gold nanoparticles has been highlighted in Discovery Channel News and won the award o. ‘One of Ten Best Inventions in 2010’.

**Potential Areas of Application:** Medicine
**Patent Status:** Patent Pending
**Inventor(s):** Nripen Chanda, Ajit Zambre, Ravi Shukla, Kavita Katti, Anandhi Upendran, Raghuraman Kannan, Cathy Cutler, Charles Caldwell, and Kattesh Katti
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ANTI-MICROBIAL PEPTIDE AGAINST H. INFLUENZA AND S. AUREUS

The discovery of penicillin in 1928 initiated a revolution in the treatment of a variety of diseases. However, extensive use of antibiotics has led to a worldwide emergence of bacterial pathogens that are resistant to current antimicrobial compounds. For example, multi-drug resistant Staphylococcus aureus (MRSA) is posing a significant threat in hospitals and is attributable to almost 20,000 deaths in the U.S. alone. Unique compounds that have increased activity against bacteria and with decreased side effects are therefore in demand.

The current invention developed by researchers at the University of Missouri is a novel anti-microbial peptide that kills Haemophilus influenza and inhibits the growth of Staphylococcus aureus. The peptide described in this
invention may have therapeutic value in the treatment of human and animal infections.

**Potential Areas of Application:** In vivo or topical administration, Bactericidal coating of abiotic surfaces, Preventing bacterial growth in fluid, Identification of H. influenza and S. aureus.

**Patent Status:** US Patent 7,238,669

**Inventor(s):** Sharon L. Bishop-Hurley, Francis J. Schmidt, Arnold L. Smith

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**PREDICTING AND INCREASING FEED EFFICIENCY OF LIVESTOCK**

The efficiency by which animals convert feed into cellular energy for maintenance and tissue accretion has a major impact on production efficiency and profitability. The more efficiently an animal converts ingested feed into cellular energy, the more work the animal is likely to perform. Additionally, the more efficiently feed is ingested, the greater likelihood that it will be converted into body mass. Currently, the only way to categorically determine the efficiency of an animal is to phenotype the animal’s feed intake and performance over time within a contemporary group.

The current invention developed by researchers at the University of Missouri is a simple blood test that ranks an animal within the population as high, mid, or low in feed efficiency. The invention provides a tool to identify animals that are genetically superior in feed efficiency and may spur additional developments that later increase feed efficiency.

**Potential Areas of Application:** Selection programs for animal species where feed efficiency is important and determining best practices for those animals based on their feed efficiency.

**Patent Status:** US patent 7,906,702

**Inventor(s):** Monty S. Kerley, William Kolath, Joseph Golden

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**CROP YIELD PREDICTION FROM AERIAL IMAGES**

Crop production is increasingly becoming dependent on technology to maximize crop yield at minimum cost and labor. Crop yield loss can occur for various reasons, one of which is nitrogen deficiency caused by wet weather. Nitrogen loss is often patchy and many crop producers do not apply rescue nitrogen when nitrogen loss has occurred, due to expense and to logistical difficulties.

The current invention developed by researchers at the University of Missouri is a technology that will predict crop yield loss at mid-season. This revolutionary technology allows corn, wheat, rice and potato producers to assess economic loss due to nitrogen deficiency and make sound business decisions about the profitability of mid-season fertilizer application. The color measured aerial imagery produced can be used to target rescue nitrogen applications to areas where profitable yield responses will be obtained, thereby maximizing the crop’s yield potential at minimum amount of labor and fertilizer.

**Potential Areas of Application:** Predict yields of crops, detect areas for fertilizer application and analyze economic outcome of mid-season fertilizer application

**Patent Status:** Patent Pending

**Inventor(s):** Peter Scharf and Vicky Hubbard

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**ENGINEERED MINI-CHROMOSOMES IN PLANTS**

The use of genetically modified crops is constantly finding new areas of application, including the production of compounds with therapeutic value. Current technology for producing transgenic crops relies on random integrations that can have variable expression and could potentially disrupt the endogenous genes. In addition, combining multiple transgenes requires a lengthy crossing scheme and can bring along linked genes from one variety into another.

The current invention developed by researchers at the University of Missouri is a technology that will allow continued addition of transgenes as the need arises using engineered plant minichromosomes. Artificial chromosome platforms were produced by telomere-mediated truncation while simultaneously adding DNA sequences that will permit amendments to the chromosome indefinitely. These minichromosomes can be used as a vector for efficient stacking of multiple genes for insect, bacterial and fungal resistances together with herbicide tolerance and crop quality traits unlinked to endogenous genes in a circumstance that would foster faithful expression.

**Potential Areas of Application:** Genetically engineered crops

**Patent Status:** US patent allowed, foreign applications pending

**Inventor(s):** James A. Birchler, Weichang Yu, Jaun M. Vega

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**NANOTECHNOLOGY-BASED ELECTROCHEMICAL DNA SENSING**

DNA is a code that contains the building instructions for all organisms and is the ultimate identification card. For example, the DNA code of a particular bacterium can tell if that particular strain of the bacterium is harmful or not. DNA sensing and recognition devices are therefore essential for accurate detection of bacteria and other microbes, as well as for the detection and identification of viruses.
Furthermore, there is a critical need to develop better methods and devices for DNA detection.

The current invention developed by researchers at the University of Missouri is a new technology that will increase the DNA sensor sensitivity, specificity, and sensing speed over current methods. This novel invention consists of an electrolyte cell, an electrochemical measurement device, and a nanostructured ceramic base electrode. The device is so sensitive that it does not require amplification of the DNA by PCR. Additionally, this device is advantageous because of its reusability, increased detection speed, and specificity.

**Potential Areas of Application:** Food Safety, Pathology and criminology, Genetic Research

**Patent Status:** Patent Application Filed

**Inventor(s):** Charles Carson, Qinson Yu, Hao Li

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**A FAST AND COST-EFFECTIVE SPORE BASED VACCINE PLATFORM**

Most vaccines created today are costly to produce. In addition, the creation of new vaccines to combat emerging diseases such as novel influenza strains like H1N1 and SARS is slow and not able to meet the demand early in the disease cycle.

The current invention developed by researchers at the University of Missouri is a new vaccine platform utilizing inactivated spores that is easy to customize to a disease of interest. The time between identification of an emerging pathogen to vaccine creation can be shortened to as little as 3 weeks. By utilizing bacterial cells that grow to high titers in simple growth medium, large batches of vaccine can be made in little time with immunogenic proteins surface displayed on the spores. Cost and timesavings are achieved because no protein purification steps are required. The spores are easily inactivated and stable in the absence of refrigeration. Bacterial spores are recognized by the immune system as foreign and have the natural ability to stimulate the immune system and lead to effective immune responses. Thus, our platform system should not need the use of adjuvants to produce a robust immune response. Lastly, we have the ability to express proteins from different antigen sources to create a multivalent vaccine against multiple pathogens.

**Potential Areas of Application:** Vaccine development and production

**Patent Status:** US Patent application 12/391,060

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**BIONANOCOMPOSITE FOR SOFT TISSUE REPAIR**

Implanted biomaterials utilized for soft tissue repair suffer from poor tissue integration, which permits sliding and rubbing of the material on the cells and tissues. This lack of control at the biomaterial tissue interface results in repeated cellular injury and chronic inflammatory response, thus leading to decreased function, chronic pain, and eventual implant removal. New soft tissue repair materials have utilized collagen scaffolds, but purified collagen is mechanically weak and chemically cross-linked collagen has inadequate biocompatibility.

The current invention developed by researchers at the University of Missouri is a mesh that achieves a higher level of control at the interface between the tissue and the implant, which translates into improved tissue integration and overall biocompatibility. The fabrication from novel bionanocomposite is relatively inexpensive, faster than conventional methods, and utilizes non-toxic, water-soluble cross-linking agents.

**Potential Areas of Application:** Hernia repair, Meniscus tissue replacement, Cardiovascular patches

**Patent Status:** Patent Application Filed

**Inventor(s):** Sheila A. Grant, Bruce Ramshaw, Sharon Bachman, Corey Renee Costello

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**MICROENCAPSULATED PROBIOTICS FOR ANIMAL FEED**

Food safety is a worldwide concern. For example, there are more than 75 million cases of foodborne illnesses in the U.S. each year leading to more than 300,000 hospitalizations and 5,000 deaths. Manure from farm animals has been shown to be a source of the pathogens contaminating processed food products. In addition, pathogens from manure on farmland may run off into water and has been shown to cause disease outbreaks. An invention that increases effective pathogen reduction while reducing the need for antibiotics would therefore be very beneficial and highly sought after.

The current invention developed by researchers at the University of Missouri is a technology that delivers to animals through their feed microencapsulated probiotics. The probiotics inhibit pathogens from growing in the gut of the animal and the novel encapsulation technology will prevent the probiotic from being killed during the digestion process before they reach the hindgut. The result is reduced fecal shedding of pathogenic microbes in animals and substantially improved food safety and increased human and animal health.

**Potential Areas of Application:** Animal food products, Reduction of pathogens on products

**Patent Status:** Patent Pending

**Inventor(s):** Azlin Mustapha, Monty Kerley, Juhee Ahn
FEED MANAGEMENT TOOL FOR AGROCHEMICAL APPLICATIONS

With increasing costs of inputs and rising concerns over environmental contamination, effective management tools are required for the application of fertilizers and other agrochemicals to maximize efficiency and reduce environmental losses. For example, enhanced efficiency fertilizer, such as slow-release fertilizers, can reduce the risks of nutrient loss compared to conventional fertilizers, but at a higher cost. One strategy to overcome in-field differences in potential nutrient loss is to apply the enhanced efficiency fertilizer to the high-risk nutrient loss areas of a field while applying conventional fertilizer to the low risk areas. An invention that would assist farmers to identify and map the low and high-risk areas of a field and then facilitate the application of multiple agrochemicals in a field based on those identified areas would help to increase profits and lower environmental losses.

The current invention developed by researchers at the University of Missouri is a software tool and algorithm to determine and apply different types and amounts of agrochemical sources to predetermined zones within a field. The tool takes into account spatial differences in intrinsic soil properties that affect agrochemical efficiency including soil drainage and water content. It allows for storage of historical data so that better management practices can be achieved and thus increasing productivity while reducing negative environmental impact.

Potential Areas of Application: Field management, control of variable source agrochemical application
Patent Status: Patent application filed
Inventor(s): Peter P. Motavalli, Kelly A. Nelson
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HYBRID SYNTHETIC-BIOLOGIC JOINT ARTHROPLASTY SYSTEM

More than one million joint replacement surgeries were performed in 2005, according to the American Academy of Orthopedic Surgeons. The demand for such procedures is expected to rise exponentially in coming years, based on rising elderly populations and an increase in sedentary lifestyle in the United States. However, existing methods of implanting joint replacements are not capable of measuring forces from a variety of real-life impact situations and cannot be tailored to an individual patient’s needs.

The current invention developed by researchers at the University of Missouri comprises a group of related implant, instruments, and techniques that provide a variety of options for performing joint replacement and resurfacing surgeries. The implants will all be composed of a synthetic component and a biologic component combined. The hybrid implants are designed to optimize long-term success in joint replacement and resurfacing surgery of all major joints by combining the advantages of synthetic and biologic arthroplasty techniques while minimizing the disadvantages of each.

Potential Areas of Application: Treat cartilage defects, Arthroplast for trauma or arthritis
Patent Status: Patent Pending
Inventor(s): James L. Cook, Clark T. Hung, Gerard Ateshian, Eric Lima
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CLINICAL TEST TO DETERMINE THE FERTILITY IN BOARS

Pork is the most consumed meat in the world. Over 100 million tons of pork meat is produced every year and there are two billion living domestic pigs at any given time in the world. The U.S. and European Union constitute approximately one-third of pork production and almost all piglets born are the result of artificial insemination. It is critical that the boars selected for breeding have high quality sperm so that insemination results in high rates of fertilization, which should result in frequent and large litters. An invention that improves the domestic pig reproductive success rate has the potential to substantially increase profitability.

The current invention developed by researchers at the University of Missouri is a specific sperm-binding test that will enable the user to predict the fertility of boars better.

The test will enable the technician to identify boars with a high count of functional sperm, which are able to bind the egg. This increases sensitivity and is a step up in contrast to tests that focus on sperm motility and morphology. This test will decrease the amount of effort and expense spent on identifying animals with low fertility. It will also increase the use of higher fertility males that will result in an increase in litter frequency and size, thereby increasing profitability and competitiveness in the pork industry.

Potential Areas of Application: Fertility testing of boars and potentially other animals
Patent Status: Provisional Patent Application filed
Inventor(s): Gary F. Clark, Peter Sutovsky
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OSTEOARTHRITIS BIOMARKER PANEL

Osteoarthritis is the most common form of arthritis in humans and affects almost 10% of the population in the U.S. and Europe. Currently, there is no commercially available assay(s) for diagnosis, staging, or monitoring of the disease. The most common clinical approach uses physical examination and radiographic (X-ray) findings for evaluation of subjects that are exhibiting symptoms. This approach results in osteoarthritis being definitively diag-
CROP RESISTANCE TO NEMATODES

Parasitic nematodes that attack the roots of plants are estimated to cause an annual worldwide crop damage of over $100 billion. For soybean, the most important pathogen is the nematode Heterodera glycines, which in the US causes an annual loss of more than 120 million bushel valued at over $1.2 billion. Other Heterodera species can cause significant damage to corn, while potato nematodes of the Globodera genus can result in up to 60% reduction in potato yield. Crops resistant to nematodes are therefore of great economic interest.

The current invention developed by researchers at the University of Missouri is a genetic approach to make plants resistant to infestation from cyst nematodes attacking soybean, corn and potato. The nematodes secrete effector proteins in order to connect with the plant’s root cells, and plants lacking the receptors these effector proteins interact with have increased nematode resistance. Disruption of the plant receptors did not result in obvious changes to root growth in the plant and can be employed to develop a novel management tactic to reduce cyst nematode parasitism of crop plants.

Potential Areas of Application: Nemmatode resistant crops of soybean, corn and potato
Patent Status: Patent Pending
Inventor(s): Melissa G Mitchum, Amy Replogle, Jianying Wang, Xiaohong Wang, Shiyan Chen, Ping Lang, Eric L Davis, Thomas J Baum, Richard S Hussey
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SEMEN STIMULATING ADDITIVE FOR ARTIFICIAL INSEMINATION

Artificial insemination is a technology that has aided both human and animal reproduction. However, artificial insemination does not always result in pregnancy whether human or animal. In the food animal production industry, an animal that does not conceive after artificial insemination results in inefficiencies and potential economic loss for the producer. In humans, the emotional toll and financial costs for couples being unsuccessful in conceiving can be substantial. Both the human and animal assisted reproductive industries are billion dollar entities and inventions that improve fertilization rates are highly sought after.

The current invention developed by researchers at University of Missouri is a simple and inexpensive additive for semen extenders and fertilization media that improves fertilization rates after artificial insemination and in vitro fertilization. In addition, mammalian oocytes fertilized in vitro in a medium with the additive have superior developmental potential, benefiting commercial embryo transfer in livestock species and infertility treatment in humans.

Potential Areas of Application: Semen extender, Media for embryo transfer in farm animals
Patent Status: Patent Pending
Inventor(s): Peter Sutovsky, Young-Joo Yi
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PORTABLE SOLAR SANITIZER FOR HUMAN AND ANIMAL WASTE

Five million individuals, primarily children, die each year from diarrheal diseases. Most of these diseases are transmitted by drinking water that is contaminated with fecal pathogens. Current strategies for disinfecting human waste are energy and water intensive and require expensive chemicals. Areas where these diseases are endemic often lack the funds and infrastructure to provide the sanitation services we take for granted.

The current invention, developed by researchers at the University of Missouri, is a solar sanitizer that uses passive solar energy to disinfect human and animal waste and reduce the transmission of diarrheal diseases. The device can be operated with a minimum amount of instruction and can either be constructed locally from recycled materials or manufactured commercially. Once the waste has been disinfected, it can be safely disposed of or used as a source or nitrogen rich fertilizer.

Potential Areas of Application: Areas with inadequate infrastructure
Patent Status: Patent Pending
Inventor(s): Daniel E. Hassett
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**TASIRNA-TECHNOLOGY FOR GENE SILENCING IN PLANTS**

It is estimated that by 2050, there will be at least 9 billion people in the world to feed. As the population increases, the agricultural industry will be expected to find ways to feed the population with fewer resources and less arable land. Thus, it is necessary to research and develop crops with higher yields or improved nutritional values to meet current and future food demands. By genetic engineering, crops can be modified to be drought and stress tolerant, pathogen and disease resistant, less dependent on the use of harmful agrochemicals, and have improved or altered nutritional values. An invention that makes it simpler to make genetically modified plants for plant research or crop production would be highly valuable.

The current invention developed by researchers at the University of Missouri is a platform that makes it simple to use trans-acting small interference RNA (tasiRNA) to silence genes in plants. A novel vector utilizes a single expression cassette as a method of delivering one or more tasiRNAs to plant cells and allows silencing of one or multiple genes simultaneously, simplifying cloning and avoiding the use of additional expression cassettes.

**Potential Areas of Application:** Post-transcriptional silencing of genes in plants  
**Patent Status:** Patent Pending  
**Inventor(s):** Zhanyuan J. Zhang, Ulku Baykal  
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**PRRSV RESISTANT PIGS**

Porcine Reproductive and Respiratory Syndrome (PRRS) is one of the most economically devastating swine viral diseases and is a worldwide problem. In 2005, PRRS caused the loss of approximately $560.32 million in revenue for U.S. swine producers. PRRS results in severe and often fatal respiratory disease and reproductive failure. It predisposes infected pigs to other viral and bacterial pathogens and is a key component of Porcine Respiratory Disease Complex. Pigs that survive the initial PRRSV infection may recover and become carriers of the disease and continue to shed the disease. Another issue in treating this disease is that PRRS transmission dynamics vary among herds and management practices. Some herds may have persistent infections whereas other herds may exhibit viral fadeout and experience reintroduction of the disease. Standardized treatment protocols for PRRS virus have eluded researchers. An invention, which eliminates PRRS from swine, would be of great value.

The current invention being developed by researchers at the University of Missouri are genetically engineered pigs that may lead to the development of PRRS virus resistant swine. These genetically engineered pigs hold great economic promise for the swine industry if they are approved for human consumption. Additionally, future uses may be identified in the field of xenotransplantation.

**Potential Areas of Application:** Swine herd health and human medical advancements  
**Patent Status:** US Provisional Patent Filed  
**Inventor(s):** Randall S. Prather  
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**DEVICE AND TECHNIQUE FOR REMOVAL OF FEMORAL HEAD**

More than 100,000 hip surgeries are performed in dogs every year. Most of the surgeries are performed as the result of hip dysplasia and many require removal of the femoral head in preparation for prosthetic replacements. Canine hip dysplasia (CHD) is the most commonly inherited orthopedic disease in dogs. Nearly all dog breeds are affected by the disease to some degree, and in some breeds, more than 50% of dogs are afflicted.

Initially designed for use in dogs, this device and technique also has a human application. Every year over 300,000 hip replacement surgeries are performed in humans. The demand for hip replacement surgeries is expected to rise exponentially in coming years, based on rising elderly population and an increase in sedentary lifestyle in the United States according to the American Academy of Orthopedic Surgeons.

The current invention developed by researchers at the University of Missouri is a novel jig that, when attached to the proximal femur, can be aligned in orthogonal anatomic planes to provide an optimal trajectory of guide pin placement and subsequent femur preparation.

**Potential Areas of Application:** Veterinary medicine – orthopedic surgery  
**Patent Status:** Patent Filed  
**Inventor(s):** Ferris Pfeiffer, Sam Franklin, James L. Cook, Derek Fox  
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**“BIOFUEL ENZYME” CDNA CLONE FOR A BOVINE PROTOZOAN ARABINOZYLANASE**

Many feedstocks including corncobs, wheat straw, woody biomass, and municipal waste are readily available and can be used for fuel. The complex structure of the biomass is more difficult to convert into ethanol than traditional starch substrates. Enzymes are vital in the conversion of biomass to ethanol.

The use of gasoline in modern society is of great concern. Global warming is a big issue worldwide. Automobiles are currently the second largest source of carbon dioxide pollution. The US Department of Energy estimates that cellulosic ethanol can reduce greenhouse gas emissions...
by at least 85% over gasoline. The potential of cellulosic ethanol is great, which is why US federal mandates require 16 billion gallon of cellulosic ethanol to be in use by 2022.

The current invention developed by researchers at the University of Missouri is a novel glycoside hydrolase enzyme. The enzyme has a substrate specificity that is highly valuable in the development of various industrial processes for the processing of biomass. The enzyme is able break down the complex structure of the biomass, which is required for the production of ethanol. The current enzyme would make cellulosic ethanol production commercially viable.

**Potential Areas of Application:** Commercial level enzyme production, Cellulosic ethanol, Biofuel  
**Inventor(s):** Gary Stacey, Seth D. Findley, Melanie R. Mormile  
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### ANTI-SARS DRUG USING ENTRY INHIBITORS

Severe acute respiratory syndrome (SARS), a serious form of pneumonia, was identified in 2003 as a new never before seen disease. There is currently no approved therapeutics for the treatment of SARS infection. SARS is a life-threatening disease that emerged from Southern China in November 2002 and spread to other parts of the world including North America, South America and Europe. The World Health Organization estimated that SARS killed ~1,000 people and had a mortality rate of ~15%. Moreover, SARS had an immense impact in the global economy costing >15 billion dollars and devastating Asian economies. Although SARS is currently not a public threat, the possibility of future outbreaks of both SARS and related viruses warrants continuous research for discovery of antiviral therapies.

The current invention developed by researchers at the University of Missouri is novel compounds for treatment of SARS. The compounds work by blocking viral entry and SARS replication by different mechanisms.

**Potential Areas of Application:** SARS and Coronavirus therapy  
**Inventor(s):** Stefan G. Sarafianos, Adeyemi O. Adedeji, and Susan Weiss  
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### DISCOVERY OF PROTEINS ASSOCIATED WITH HYBRID VIGOR IN CORN

Hybrid vigor (heterosis) has long been used by plant breeders to improve yield, thus improving world food production. However, the changes that are responsible for heterotic responses and their mechanisms remain undefined. To date, no specific biochemical pathways have been established to reveal a direct connection to multigenic heterosis.

The current invention developed by researchers at the University of Missouri show that efficient energy metabolism and stress response mechanisms are important factors in heterosis. Metabolism proteins such as glycolysis, TCA cycle, photorespiration and mitochondrial electron transport chain were all affected in higher heterosis hybrids. Specific isoforms confer changes in protein properties that contribute to increased vigor. The data also suggest that differently accumulated proteins could become biomarkers for heterosis.

**Potential Areas of Application:** Early assessment of hybrid vigor in plants  
**Inventor(s):** Diwakar Dahal, Brian Mooney, Kathleen Newton  
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### GENETIC MODEL STUDYING THE BIOLOGICAL PATHWAYS CONTRIBUTING TO PHYSICAL INACTIVITY AND MOTIVATION

In the United States, approximately 95% of adults and 92% of adolescents are not meeting U.S. guidelines for 30 and 60 minutes of daily physical exercise respectively. While failure to be physically active is multi-factorial (e.g. cultural, time, access etc), lack of motivational behavior must also be a contributor as a small human subpopulation continues to be motivated for physical activity.

The current invention developed by University of Missouri researchers is a rat model using a specifically bred line of rats to study biological pathways influencing physical inactivity and motivation. The researchers developed a line of genetic rats that were selectively bred to voluntary run high (HVR) vs. low (LVR) distances in order to examine if dopamine-like 1 (D1) receptor modulation in the nucleus accumbens (NAc) differentially affects nightly voluntary wheel running between the two lines of rats. The low line of voluntary running rats is novel and can be used as a model to study the biological and motivational factors that influence physical activity. The goal is to make low distance runners become high distance runners and apply the therapy to humans to motivate “couch potato” humans to become physically active which will then have positive health outcomes.

**Potential Areas of Application:** Development of pill or therapeutics to increase physical activity  
**Inventor(s):** Michael Roberts, Leigh Gilpin, Kyle Parker, Thomas Childs, Matthew Will and Frank Booth  
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METHODS TO INCREASE PLANT OIL PRODUCTION

Plant-derived oils are a major commodity, providing a main source of calories and essential nutrients for humans and animals. Vegetable oils have become increasingly important sources of renewable materials for industrial feedstocks and biofuels. Oils are the most energy-dense products that plants produce in large quantities using solar energy and CO2. However, insufficient supply of the feedstock has been one of the biggest challenges in using plant oils as biofuels and other renewable industrial materials.

Researchers at the University of Missouri-St. Louis and the Donald Danforth Plant Science Center have identified new genes, new pathways and new mechanisms to increase oil production in plants. The findings are applicable to significantly enhancing oil production in photosynthetic organisms including corn, soybean, rapeseed, sunflower, brassica, etc.

BENEFITS

- 20% – 30% oil production increase shown in Arabidopsis thaliana (greenhouse)
- Results from small field trial in soybean:
  - 15% oil production increase in soybean
  - The increase in oil production comes at the expense of carbohydrates, not protein
  - Germination is not affected
  - No change in the 100-seed weight
  - No change in per-plant yield

Potential Areas of Application: Increase production of oil from plants/crops for use in: biofuels/biodiesel, renewable materials, high-energy livestock feed, flavor and fragrance industries, Cooking and food production, Omega-3 production for use in many food products, Natural cleaning products that contain plant oils

Patent Status: PCT/US11/56861 filed 10/19/11
Inventor(s): Xuemin “Sam” Wang, Geliang Wang, Maoyin Li
Contact Info: Tamara Wilgers, UMSL, WilgersT@umsl.edu, 314-516-6884

ENHANCING WATER-USE EFFICIENCY AND DROUGHT TOLERANCE OF PLANTS

Terrestrial plants experience water deficits under different growth conditions, such as drought and high salinity. Researchers at the University of Missouri-St. Louis and the Danforth Plant Science Center found that membrane lipid-metabolizing enzymes and lipid mediators play pivotal roles in plant water usage and drought tolerance.

Decrease water loss, increase water-use efficiency: Much of water absorbed by the roots of a plant is lost through small pores (i.e. stomata) on leaves. We have discovered a bifurcating signaling pathway that mediates stomata movement and water loss. Fine-tuning the approach has the potential to increase water-use efficiency, as measured by the marketable crop, such as seeds or biomass, produced per unit volume of water.

Enhance root growth, drought tolerance: Roots play a critical role in water absorption from soil and help plants maintain water status. We have identified genes that promote root growth in response to water deficits. Knockout of the genes renders plants shorter with fewer roots whereas increasing their expression increases root length and number. Manipulation of these genes improves plant growth under drought and high salinity. In addition, alteration of these genes results in changes in flowering time under drought (early flowering accelerates plant life cycle helping plants avoid stresses).

Integration of multiple stresses to optimize plant growth: Water deficits can be caused by different stresses (e.g. drought and high salinity), and drought is often associated with other stresses (e.g. nutrient deficiency, high temperature). Our studies indicate that some membrane-based regulatory processes are a key integrator of stresses for optimal plant growth in response to drought/nutrient stresses. Manipulation of these processes can increase biomass production via improved water-use efficiency/drought tolerance.

Potential Areas of Application: Increase drought tolerance in plants

Patent Status: US Publication #2010/0037351 entitled Alteration of Phospholipase De (PLDe) or Phospholipase Da3 (PLD) Expression in Plants
Inventor(s): Xuemin “Sam” Wang, Yueyon Hong
Contact Info: Tamara Wilgers, UMSL, WilgersT@umsl.edu, 314-516-6884
**SUBSURFACE CONTAMINATION ANALYSIS WITH SOLID PHASE MICROEXTRACTION**

This technology is an in-planta analysis of soil and groundwater contaminants. It uses durable, rapid analytical techniques to delineate subsurface contamination as well as find evidence of natural attenuation of contaminants.

Subsurface contaminant delineation is expensive, time intensive and causes excessive ecological and environmental damage. The in-planta analysis developed by researchers at the Missouri University of Science & Technology allows for rapid analysis for soil and groundwater contaminants in the field to delineate subsurface contamination, particularly with respect to volatile organic compounds. Using a variety of analytical techniques, analyses can provide detection in the nanogram/liter range in plant tissues and can provide accurate quantitative analysis. In-planta sampling can also provide evidence of natural attenuation of contaminants by detecting degradation products.

This invention has several commercial applications related to site investigation and monitoring for organic contaminants. The invention can be used for activities such as detection of presence and concentration of contaminants in vegetation, delineation of a groundwater plume, monitoring and tracking contamination, assessment of vapor intrusion potential in buildings, and projection of contaminant exposure history. It also allows for these rapid investigations of contaminations sites while simultaneously providing quicker, more accurate results than traditional methodologies. The assembly is durable and can be used to test in areas inaccessible to other regimes and is an economical process.

**Potential Areas of Application:** Analysis of soil and groundwater contaminants  
**Patent Status:** Patent Pending  
**Inventor(s):** Burken, Joel  
**Contact:** Eric Anderson, Missouri S&T, EricWA@mst.edu, 573-341-4551

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**DURABLE**

Enginuity Worldwide LLC researchers and engineers have invented a cost-effective process to transform annually renewable biomass feedstocks and waste materials into energy-dense solid fuel for use in power facilities. The innovation has been shown by studies supported by Missouri Agricultural Small Business Development Authority (MASBDA) and Missouri Corn Merchandising Council (MCMC) to be effective for use with a wide variety of biomass sources.

Enginuity is focused on accessing best-in-world biomass resources to create a new resource for home-grown power, delivering energy independence to our customers. The Enginuity innovation allows for multiple streams of diverse annually renewable biomass feedstocks to be processed into a homogeneous, predictable and repeatable engineered carbon-free solid fuel. Power generation using the carbon-free resources is then, in turn, carbon-free, or even engineered to be carbon negative. The successful implementation of Enginuity’s technology will be a step-change improvement in accessing the vast biomass stores in the nation’s heartland to produce globally valuable carbon-negative power.

The Enginuity approach to biomass fuel is focused on the materials engineering, and initially was built upon a low-cost, highly effective, binder approach. The binder is added at less than 2%, is combustible, and typically yields durability of 98-99.9% (using PDI index protocol). Moreover, the patent pending processes have been shown to produce engineered fuel that has higher energy content and more environmentally efficient than current alternatives.

This critical new process is a step change innovation for biomass to power. To date, no one has been successful in reaching the durability needed to market distribute a biomass fuel source at an overall efficiency that allows annually renewable to be economically competitive. It is not believed, based on information received directly from biomass associations and government officials, there is a process that allows the cost-effective distribution of annually renewable biomass fuel in the market place, either domestically or internationally. In addition, the only current biomass available that meets the durability standards for shipping to overseas markets is a wood-based biomass pellet. Enginuity’s innovation allows other feedstocks to meet that standard.

**Potential Areas of Application:** Creating biomass for fuel source  
**Patent Status:** Patent Pending  
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