

Understanding Foal Immunity *In Utero* and Beyond



When environmental bacteria, viruses, fungi, and parasites bombard the foal, his health is challenged. But that challenge also stimulates the immune system, helping it mature.

Foals have a functional immune system at birth. Actually, they have a functioning immune system *in utero*—but it's one appropriate to an unborn foal in a sterile and protected environment. Once that baby hits the real world, he needs real-world immunity.

The science behind immunity is complex, but the lessons it teaches us can be very practical. At the 2016 American Association of Equine Practitioners (AAEP) Convention, held Dec. 3-7 in Orlando, Florida, David W. Horohov, PhD, of the University of Kentucky (UK) Maxwell H. Gluck Research Center, in Lexington, described aspects of immunity that are useful in everyday mare and foal management.

With six layers of placenta separating the mare's circulation from the fetus,

only small molecules can get through to the foal. Large proteins, such as antibody molecules, cannot. And while a newborn foal's immune system is competent in that all the players are present, aspects of it are immature. The lack of antibodies leaves the foal unprotected against bacterial and viral infections. As a result, the foal depends on the mare's colostrum (her antibody-rich "first milk") to provide the necessary antibodies through a process called passive transfer.

Of course, the amount of antibodies the foal gets depends on the mare's antibody levels, Horohov said. So, boosting her antibodies by vaccinating her according to AAEP guidelines helps assure sufficient antibody levels. Mares also develop antibodies as they are naturally exposed to pathogens in the environment, which ultimately helps foal immunity.

When bacteria, viruses, fungi, and parasites bombard the foal, his health is challenged. But that challenge also stimulates the immune system, helping it mature.

Over time, the from-the-mare antibodies decay, so as critical as they were for the newborn, the 4-month-old foal no longer benefits from them. By then, he's building immunity on his own.

The caveat comes when foals fail to get adequate colostrum or the colostrum doesn't contain those critical antibodies. In this scenario, neonatal foals are highly susceptible to bacterial infections. Veterinarians might recommend vaccinating those young foals to protect against disease. While the young foal's immune system won't make antibodies as effectively as an older foal's would, no adverse long-term effects of early vaccination have been noted, and it will help the foal mount a defense.

Bottom line: Vaccinating the mare is the No. 1 thing you can do to ensure a foal has the best chance at fighting off most of the bacteria and viruses that he'll encounter in his early days. **UK**

>Maureen Gallatin is a freelance writer, founder of Horses on a Mission, and author of the inspirational devotional, *An Extra Flake*.

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New Perspectives on Foal Nutrition

During the 2017 UK Equine Showcase, Laurie Lawrence, PhD, professor in the department of animal and food sciences at UK, presented on the equine neonatal diet and some recent related research she and her team have conducted.

She recognized contributions made by several collaborators, including Morgan Pyles and Susan Hayes, of UK's Department of Animal and Food Sciences, and Michael Flythe, PhD, of the USDA Agricultural Research Services unit, located on UK's campus.



Dr. Laurie Lawrence hopes to further study mare's milk and microbial colonization in the foal's GI tract.

A new foal's diet consists mostly of milk, Lawrence said. Recently, she and colleagues completed a preliminary study in which they analyzed mare's milk content. They obtained milk samples from 16 Thoroughbred mares within an hour of foaling, approximately 24 hours after foaling, and approximately three days after foaling, and analyzed the samples' insulin and cortisol content.

The team found that both cortisol and insulin were present in mare's milk, with especially high levels in colostrum. Lawrence believes this could indicate that there are other hormones or growth factors in colostrum. And although she's not entirely sure why cortisol and insulin were present in milk, or how important these findings

are, she said, "Mother Nature hardly does anything without a reason."

Another important part of foal nutrition is the transition from a milk-based diet to a fiber-based one. Microbes in the large intestine are important for digesting fiber—the backbone of an adult horse's diet—and understanding how foals acquire these essential bacteria is, therefore, an important part of the dietary transition.

This led to the second study Lawrence described in her presentation, in which she and colleagues assessed mare and foal fecal samples starting at birth and throughout the foal's first month of life. The team paid special attention to the samples' microbial content.

Theoretically, all milk components should be digested in the small intestine, Lawrence said. However, from Day One, foals had starch-utilizing bacteria in their fecal samples. This led Lawrence to conclude that some starch, sugar, or carbohydrates from milk must be reaching the foal's large intestine, resulting in the bacteria's presence.

In humans, Lawrence explained, oligosaccharides (a type of carbohydrate) in milk are believed to be important to microbial colonization in the gut. Based on their study findings, her team plans to look more closely at carbohydrates in mare milk.

This new information is relevant in several ways, Lawrence said. Firstly, microbes in the horse's gut help with food digestion, which makes them important to assess and understand. Microbes also help protect the digestive tract from pathogens. Foal diarrhea is a problem nearly every breeder encounters, and a better understanding of foals' gastrointestinal (GI) tract microbial colonization could reveal factors that increase the risk of neonatal diarrhea.

Going forward, Lawrence said these studies have peaked her interest in other components of mare's milk and the foal's GI tract. In the future, she would like to characterize mare milk more thoroughly, identify the "first responders" that colonize a foal's digestive tract, and identify the factors that improve or impair the colonization of the foal GI tract. **UK**

>Maddie Regis is a sophomore marketing major at UK and communications and student relations intern within UK Ag Equine Programs.

Masthead

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Commentary: Accelerating Medical Progress on Equine Lameness

In the horse world, lameness is a major problem. On this point, everyone agrees. Whether your focus is elite equine athletes or pleasure horses, whether you are a professional or a recreational rider, whether your primary breed of interest is large or small, musculoskeletal injuries are common and potentially very serious.

Substantial progress has been made over the last few decades in both lameness diagnosis and treatment. Importantly, the future holds as much promise as ever. Science and technology are continuing to drive advances in clinical disciplines.

Cell biology is a good example. With next generation sequencing applied on a genomic scale (inclusive of all DNA or all RNA), it is now possible to broadly compare gene expression between individual tissues and cell types. Data-driven scientific approaches are discovering a large number of genes that nobody realized were important. The results are providing new insights into cellular identity, normal function, and disease mechanisms in areas that have direct relevance to lameness.

New understanding about individual cell types enables diagnostic and therapeutic strategies to be refined. Consider cartilage as an example. Our bodies contain several different cartilaginous tissues—joint (articular) cartilage, non-articular structural cartilage, cartilage replaced by bone through a process called endochondral ossification, and others. Although all types of cartilage have features in common, an understanding of the unique

cellular characteristics that define articular chondrocytes are important to consider with joint diseases.

Going forward, veterinarians will increasingly have access to molecular biomarker panels to help refine their list of differential diagnoses, to select optimal therapies, and for patient monitoring. We already hear about these approaches with cancer patients, and the same concepts are applicable for bone, cartilage, tendon, ligament, and muscle tissues. The clinical goals include improved sensitivity in monitoring health as well as early identification of disease problems and how the patient is responding to treatment.

On a therapeutic level, cell-based approaches are generating high levels of interest and for good reasons. “Stem cells,” for instance, can be used therapeutically to deliver beneficial equine-specific growth and differentiation factors to an area of injury, to modulate the patient’s immune system in helpful ways, and in some cases to directly generate a repair tissue. There is much to learn and quite a bit of misinformation being disseminated, but cell-based therapies do indeed hold a lot of promise.

Finally, we have entered the era of medical informatics. Hardware, software, and data storage options in computer science have advanced rapidly to enable “big data” analyses that resolve biomedical relationships and patterns from “-omic” and population levels that would be very hard to appreciate by looking only at an individual



KEVIN THOMPSON/THE HORSE PHOTOS

Science and technology continue to drive advances in lameness diagnostics and treatments.



gene or a single patient. By analogy, consider how difficult it would be to resolve crop circles and other patterns in a grain field while standing on the ground. They are much easier to appreciate while looking out the window of an airplane. It is not an “either/or” issue—broad and targeted analyses are both important and often complementary.

So, how can we facilitate further progress in addressing equine lameness challenges? A very important part of the answer is quality scientific research to advance knowledge. At UK, we have established the Equestrian Sports Research Initiative to enable multi-disciplinary research teams to work together collaboratively with industry groups,

clinical veterinarians, and horse professionals. Health and welfare issues in equine sports medicine are being studied from basic to clinical levels by considering horse, rider, and surface issues concurrently. As noted above, scientific and technological advances are driving progress in biomedical disciplines. Objective scientific research and the resulting new knowledge are absolutely key, and need to be a top priority. **UK**

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> This is an excerpt from *Equine Disease Quarterly*, funded by underwriters at Lloyd’s, London.

UK Gluck Center's Loux Receives Storm Cat Career Development Award

Shavahn Loux, PhD, a postdoctoral scholar at the UK Gluck Equine Research Center, recently received the Storm Cat Career Development Award, granted by the Grayson-Jockey Club Research Foundation (GJCRF).

Loux is studying mares' microRNA (miRNA) population throughout normal gestation and during experimentally induced placentitis (inflammation of the placenta) episodes. She and colleagues will send RNA isolated from chorioallantois (fetal membranes) at six, eight, and 10 months of gestation to the University of Illinois R. J. Carver Biotechnology Center, in



UNIVERSITY OF KENTUCKY

Shavahn Loux

Urbana, for next-generation sequencing to fully characterize the miRNA population at each interval and maximize the data generated from each sample. The team will use a quantitative PCR to verify significant changes.

"I am very honored by the Grayson-Jockey Club Research Foundation's decision to award me with the 2017 Storm Cat Career Development Award," Loux said. "Receiving these funds will allow me to continue my cutting-edge research into the physiology of pregnancy and pregnancy-related disease in the horse, as well as provide opportuni-

ties for future funding. Ultimately, I believe this award reflects well not only on me, but also on the high-quality research consistently performed here at the Gluck Equine Research Center."

Barry Ball, DVM, PhD, Dipl. ACT, Albert G. Clay Endowed Chair in Equine Reproduction at the Gluck Center, is Loux's advisor.

The annual \$15,000 award, inaugurated in 2006, is designed "as an early boost to an individual considering a career in equine research," says the GJCRF's website. It is funded by Lucy Young Hamilton, a GJCRF board member and past Gluck Equine Research Foundation board member. Hamilton's family stood champion Thoroughbred stallion Storm Cat at Overbrook Farm, in Lexington, Kentucky. **UK**

>Jenny Evans, MFA, is the senior veterinary science marketing and promotion specialist at the UK Gluck Equine Research Center.

GRAD STUDENT

SPOTLIGHT

VICTORIA TAYLOR

From: Muhlenberg County, Kentucky
Degree and institute where received:
BS, Animal Science, University of Kentucky

Victoria Taylor grew up on a small horse farm and knew at an early age she wanted to pursue a degree in animal agriculture, including veterinary or graduate school. After touring a handful of schools, she visited UK and got a warm, fuzzy, "homelike" feeling she didn't find anywhere else.

"The people I met on tours were kind and welcoming and were eager to answer all of my questions," Taylor said. "The opportunities here are endless and, as a horse enthusiast, it made sense."

Taylor asked her parents' opinions before officially deciding to attend UK. Ultimately, the fact that she could be her family's fourth generation to attend UK sealed the deal.

Taylor is currently completing her master's degree and studying equine reproductive physiology. Her research is predominately focused on comparing Kentucky 31 tall fescue and a novel endophyte tall fescue and how they affect grazing nonpregnant and pregnant mares. Fescue is known to cause ergotism, commonly known as fescue toxicosis, in livestock, including horses.

"Fescue toxicosis can negatively influence average daily gains, gestation (pregnancy) length, parturition, milk production, and thermoregulation," Taylor said.

In her research Taylor has looked at vasoconstriction (blood vessel constriction), hormone concentrations, gestation length, thickened placentas, placental weights, combined uterine placental thickness,



foal birth weights, and ergovaline concentrations of pastures.

"We're trying to fully understand how everything ties together, so we can determine a way to see if horses have consumed a high amount of ergovaline before it's too late," Taylor said. "In addition, novel endophyte fescue appears to have the same effects as grazing orchardgrass/bluegrass fields, suggesting it's a safe alternative to the traditional Kentucky 31 tall fescue."

Taylor is studying under Karen McDowell, PhD, EMB, associate professor in the UK Department of Veterinary Science. Her team of collaborators includes Glen Aiken, PhD, director of the USDA Agricultural Research Service, specializing in forage-animal production research; Michael Barrett, PhD, professor in the UK Department of Plant and Soil Sciences; Tim Phillips, PhD, as-

sociate professor in the UK Department of Plant and Soil Sciences; and Cindy Gaskill, DVM, PhD, Dip. ABVT, clinical veterinary toxicologist at the UK Veterinary Diagnostic Laboratory.

Taylor said one of the biggest lessons she's learned is that she doesn't have to choose between industry and academia.

"If I choose to stay in academia, I can still work with industry leaders, answering their questions and helping them through the day-to-day challenges they may encounter," she said. "As animal scientists, we have the responsibility of enhancing animal livelihood, something we most definitely can achieve if we work together."

Taylor plans to graduate in May 2017 and her post-graduation plans include further education or a job in the industry. **UK**

>Alexandra Harper, MBA, is the operations and communications coordinator for UK Ag Equine Programs.

UK Veterinary Science to Host Second Three-Minute Thesis Competition for Doctoral Students

The UK Department of Veterinary Science will host its second annual Three-Minute Thesis (3-MT) competition for PhD candidate (i.e., post-qualifying examination) graduate students to present their research projects on April 7 at 3 p.m. in the UK Gluck Equine Research Center auditorium.

Daniel Howe, PhD, professor and director of graduate studies in the UK Department of Veterinary Science, said the competition's purpose is to, "encourage the students to develop skills in communicating their research in a very concise and efficient manner."

The 3-MT, which were

originally developed at a university in New Zealand, rules allow students three minutes to discuss their research using only one presentation slide and no gimmicks (e.g., props, costumes, songs, etc.)

Three faculty members from various departments in the College of Agriculture, Food and Environment will judge the competition.

The presenting PhD candidates will be announced the week of the competition on the [Gluck Equine Research Center's Facebook page](#). **UK**

>Jenny Evans, MFA, is the senior veterinary science marketing and promotion specialist at the UK Gluck Equine Research Center.

Annual Career Fair Unites College Students, Equine Industry

More than 120 college students attended the UK Ag Equine Programs' ninth annual Equine Career and Opportunity Fair March 7 in Lexington.

The free event provided college students the chance to meet prospective equine industry employers and to learn about potential volunteer, internship, and part- and full-time employment opportunities. In addition to booths from area equine businesses, attendees participated in sessions led by industry professionals who offered tips and one-on-one career advice. Those sessions included veterinary professions, the Thoroughbred industry, feed sales/nutrition, marketing/communications, and graduate school. **UK**

>Holly Wiemers, MA, APR, is communications director for UK Ag Equine Programs.

UKVDL Disease Mapping Initiative Featured Map

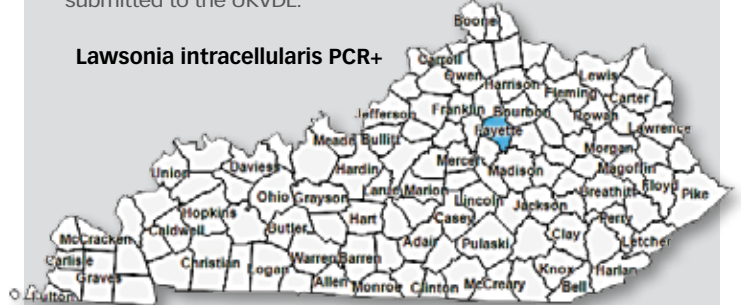
Lawsonia in Kentucky Equids

Lawsonia intracellularis, the bacterium that causes equine proliferative enteropathy (EPE) mostly in young horses, can result in thickening segments of small intestines and sometimes large intestines. *L. intracellularis* does not grow in routine aerobic/anaerobic culture and can only grow *in vitro* (in the laboratory) in cell culture, which is not practical.

Clinical signs include depression, anorexia, fever, peripheral edema, hypoproteinemia, hypoalbuminemia, weight loss, colic, and diarrhea in affected foals. Early clinical signs are generally nonspecific and include mild depression, partial anorexia, and fever.

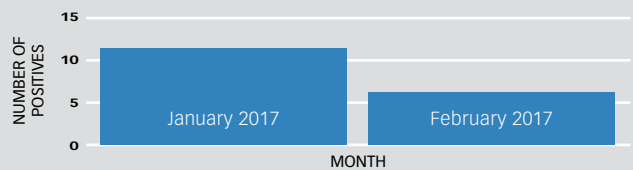
For questions or concerns about disease outbreaks, contact UKVDL at 859/257-8283. **UK**

>Jacqueline Smith, PhD, MSc, BSc, Dipl. AVES, UKVDL epidemiologist and adjunct professor of epidemiology at Lincoln Memorial University, is the founder of the UKVDL Disease Mapping Initiative, a database designed to record all infectious disease cases submitted to the UKVDL.



Legend: 1-5, 6-10, 11-15, 16-20, >21

Lawsonia intracellularis PCR+



See each month's featured map at vdl.uky.edu/FeaturedMap



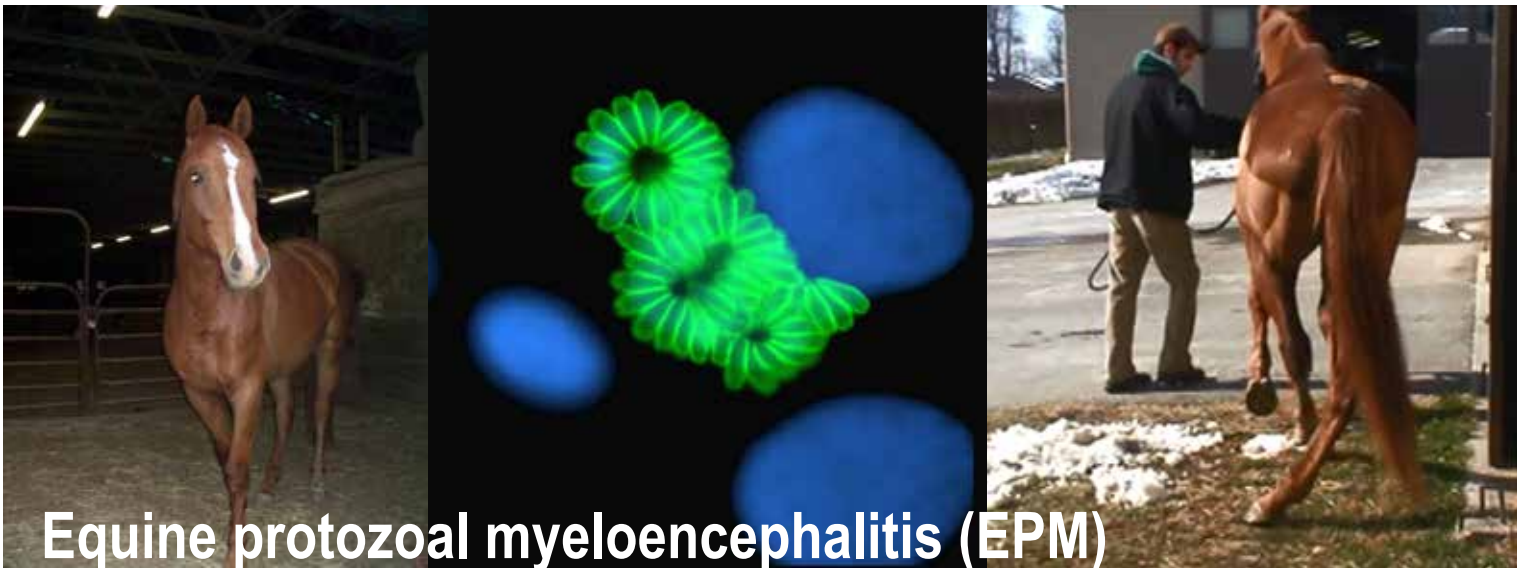
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Equine protozoal myeloencephalitis (EPM)

Equine protozoal myeloencephalitis (EPM) is a serious neurologic disease that can affect horses in North, Central and South America. The disease is typically caused by the protozoan parasite *Sarcocystis neurona*, although the related parasite *Neospora hughesi* has been found to be the cause in a small number of cases. *Sarcocystis neurona* is transmitted to other animals, including horses, in the feces of infected opossums. Although other animals such as raccoons, skunks and armadillos can be infected and contribute to the natural life cycle of *S. neurona*, these animals do not transmit the parasite to horses. Similarly, *S. neurona* is not passed between horses. **More importantly, horses are commonly exposed to *S. neurona*, but EPM only occurs in a minor proportion of the infected horses (less than 1%).**

Clinical Signs

These are highly variable with no clinical signs specific for EPM. Many neurologic diseases can produce signs similar to EPM such as:

- Unusual lameness
- Difficulty swallowing
- Uneven muscle loss
- Difficulty standing or walking, stumbling, interference between limbs
- Severe cases can lead to recumbancy/inability to rise
- Signs may progress slowly or rapidly

Diagnosis

Proper diagnosis requires a thorough neurologic examination combined with appropriate laboratory tests. Laboratory tests should not be a substitute for an in-depth clinical examination. Horses with clinical signs consistent with EPM should be tested for the production of antibodies against the parasite in the central nervous system (CNS).

- CNS antibody production is evaluated by testing both a blood sample and a cerebrospinal fluid sample from a suspect EPM horse
- Testing for antibodies in blood alone is not informative since many horses are exposed to the parasite but only a few are afflicted with EPM

Treatments and Preventions

Early diagnosis and treatment is important to help minimize neurologic damage, which may not resolve completely. It is not possible to completely prevent EPM in regions of the world where the disease is known to occur. However, reducing access of opossums to food and water sources will reduce exposure to the parasite, thereby lessening the likelihood of EPM. There are several FDA-approved drugs that are available commercially and effectively block growth of the parasite:

- ReBalance from PRN Pharmacal is an oral suspension containing a combination of pyrimethamine and sulfadiazine
- Marquis from Merial is an oral paste containing 15% ponazuril
- Protazil from Merck Animal Health is an alfalfa-based pelleted treatment containing 1.56% diclazuril

Current Research

The immune responses of EPM horses is being investigated at the University of Kentucky Gluck Equine Research Center. This may reveal why EPM horses get sick, while many horses remain clinically normal when infected by *S. neurona*. The genome of *S. neurona* has also been sequenced and analyzed. This information will improve our understanding of the parasite, which helps combat it by revealing potential targets for new drugs and protective vaccines.



4 Misconceptions About Alfalfa

Despite all the science-backed suggestions about feeding alfalfa, it remains a misunderstood forage.

Despite all the science-backed suggestions about feeding alfalfa, it remains a misunderstood forage. The following are a few misconceptions worth clarifying.

MYTH: An alfalfa-rich diet causes kidney problems.

“A normal, healthy horse can metabolize and excrete the extra protein in alfalfa just fine, if the horse has adequate water,” says Ray Smith, PhD, UK forage extension specialist. Horses with kidney disease shouldn’t consume a high-protein diet (such as alfalfa), but the alfalfa itself won’t cause kidney disease.

MYTH: Alfalfa makes horses hyper.

“I don’t think there is any scientific basis for this,” says Krishona Martinson, PhD, associate professor and equine extension specialist at the University of Minnesota’s Department of Animal Science, in Falcon Heights. “Alfalfa does have more energy compared to grass hay of similar maturity, so perhaps a horse eating a lot of alfalfa in the absence of exercise may have more energy. The biggest issue with alfalfa, however, is weight gain in horses that don’t have adequate exercise.”

MYTH: Alfalfa has high nonstructural carbohydrate (NSC) levels.

“Cool-season grasses like timothy, bromegrass, and orchardgrass actually have higher nonstructural carbohydrate content and sugars than legumes,” says Martinson. “Horses with carbohydrate sensitivity (e.g., obese horses, those with laminitis, equine metabolic syndrome, equine

Cushing’s disease, or polysaccharide storage myopathy) need their diet carefully monitored for nonstructural carbohydrates and can benefit from including some alfalfa rather than grain or cool-season grasses.”

MYTH: Alfalfa aggravates respiratory problems in horses with heaves.

Some horses tend to cough more when fed alfalfa, but this is due to irritants such as dust and mold rather than the alfalfa itself. Alfalfa can be dustier than grass hay when moisture conditions at baling are less-than-ideal. Alfalfa leaves also tend to shatter when too dry, creating more dust particles.

“Mold formation is also related to moisture content when baling,” says Martinson. “One issue with alfalfa—which tends to have more stem than grass—is that the stem takes longer to dry. Alfalfa might take 12 to 24 hours longer to dry than a grass crop, simply because it has more stems. Moldy grass hay or moldy alfalfa hay both cause airway irritation when mold dust is inhaled.”

Take-Home Message

The horse industry is full of misconceptions about alfalfa. Before dismissing this nutrient-rich forage, contact your veterinarian or equine nutritionist to develop a feeding program that’s right for your horse. [UK](#)

>Heather Smith Thomas has raised and trained horses for 50 years, and has been writing freelance articles and books nearly that long.

UK to Host Second Equine Nutrition Short Course

The second annual UK Equine Nutrition Short Course will be held May 13 from 8:30 a.m. to 4 p.m.

Presented by UK Ag Equine Programs' Equine Nutrition Working Group, the event is designed for horse owners who want to understand how nutritional management can affect their horses' health and performance.

Morning lectures will be held at the UK Veterinary Diagnostic Laboratory and will cover how to determine if a horse needs an immune supplement and if he is getting enough (or too much) protein; healthful hay and grain; and horse nutrition myths and mysteries.

Afternoon labs will be held at UK's Maine Chance Farm and will include:

- Hands-on evaluation skills for determining if a horse is fit or thin and what is fat or muscle;
- Feeding through a horse's life cycle, including the right feeds and supplements for performance, growth, and reproduction;
- Best hay feeding practices, including whether dry, soaked, or steamed forage is right for your horse; and
- Pasture and hay evaluation.



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Attendees will learn about feeding horses at different life stages, pasture evaluation, and more.

The \$75 registration fee includes lunch and materials. Register online at 2017ukequinenutrition.eventbrite.com. UK

>Holly Wiemers, MA, APR, is the communications and managing director for UK Ag Equine Programs.

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UK Maxwell H. Gluck Equine Research Center: @UKGluckCenter

NEW!! UK Veterinary Diagnostic Laboratory: @UKVDL



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UK Ag Equine Programs An overarching framework for all things equine at UK, including the undergraduate degree program, equine-related student organizations, equine research, and outreach activities.

UK Equine Alumni A community established for the alumni of UK's equine programs, including ESMA, graduate students, and club and team members.

UK Maxwell H. Gluck Equine Research Center The Gluck Center's mission is scientific discovery, education, and dissemination of knowledge for the benefit of the health and well-being of horses.

NEW!! UK Veterinary Diagnostic Laboratory The UKVDL's mission is to develop and apply state-of-the-art diagnostic methodology to improve animal health and marketability, to protect the public health, and to assist in the preservation of the human-animal bond through the principles of One Health.

UK Horse Pasture Evaluation Program A service program offered to Kentucky horse farms with the goal of overall improved pasture management.

Saddle Up SAFELY A rider safety awareness program sponsored by UK HealthCare; the UK College of Agriculture, Food and Environment; and community organizations. It aims to make a great sport safer through education about safe riding and horse handling practices. UK

Upcoming Events

April 7, 3 p.m.

3-MT (Three-Minute Thesis) Competition
Presented by the UK Department of Veterinary Science, UK Gluck Equine Research Center Auditorium

April 26, 8 a.m.

Equine Summit "Developing Tomorrow's Equine Workforce"
Spindletop Hall, Lexington, Kentucky

May 13

UK Equine Nutrition Short Course
UK Veterinary Diagnostic Laboratory and Maine Chance Farm, Lexington, Kentucky.

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