UK Ag Equine University of Kentucky

BLUEGRASS EQUINE DIGEST

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Toxin Topic: Ionophore Intoxication in Horses

A recent recall of horse feed contaminated with the ionophore antibiotic monensin has prompted many questions about this feed additive and its risks to horses.

Ionophore antibiotics are feed additives used to improve weight gain and control coccidiosis (a protozoan infection) in ruminants, swine, and poultry. Ionophores can also potentially reduce the incidence of a number of digestive and respiratory conditions in cattle. Several ionophores are approved for use in the United States, including monensin, lasalocid, salinomycin, narasin, maduramicin, laidlomycin, and semduramicin.

Ionophore antibiotics can contaminate horse feeds.

Horse feeds, however, should never intentionally contain ionophores, as ingesting large amounts can be fatal to horses. Occasionally, horse feeds are contaminated; the risk this poses to horses depends on how much ionophore is in the feed and how much the horse ingests.

Many cases of ionophore poisoning occur in nontarget species (i.e., species for which ionophore use is not approved). However, poisoning can also occur in the intended species if an animal ingests excessive amounts. Most often this occurs when excessive amounts of ionophores are accidentally added to feeds, or when animals have accidental access to concentrated pre-mix formulations.

Horses are much more susceptible to ionophore toxicity than are other species. For example, horses are nearly 20 times more sensitive than cattle and 200 times more sensitive than poultry to monensin toxicity, on a mg monensin per kg of body weight basis. However, not all ionophore exposures are necessarily dangerous to horses—as mentioned, risk depends on the amount ingested. If a horse eats

ARTICLES OF INTEREST

(IONOPHORES ...)

just a few mouthfuls of feed containing the approved amount of monensin for cattle (33 ppm, or parts per million), for example, the horse will suffer no adverse effects. Even if the horse eats a small amount of this feed every day for several weeks, the horse might develop only transient anorexia and nothing more serious. However, if a horse ingests several pounds of feed containing very large amounts of monensin, such as 200-300 ppm, this could easily cause death. Studies have indicated that dosages of 1.4 mg monensin per kg of body weight can be fatal to a horse. Minimum toxic dosages for many of the other ionophores have not been well-established in horses.

Ionophore intoxication damages heart and skeletal muscle and has other effects by mechanisms that are not well understood. Clinical signs of ionophore poisoning in horses vary depending on the dosage ingested, but can include poor appetite and feed refusal, diarrhea, weakness, rapid heart rate, depression, wobbly gait, colic, sweating, recumbency, and sudden death. Animals that recover from sublethal poisoning can develop chronic heart failure resulting in exercise intolerance, poor performance, and even death.

Diagnosing ionophore poisoning can be difficult, but suspect a feed-related toxicity if horses become sick after being fed a new batch of feed and/or multiple horses are affected at the same time. Contact your veterinarian immediately if you suspect your horse might have been exposed to ionophores. He or she can run diagnostic tests on the patient and on the feed to help determine if exposure has occurred. Remove the suspected feed immediately, but save it for testing if needed. As discussed above, the mere presence of an ionophore in the feed is not proof of poisoning; the amount matters, so quantitative analyses should be performed on a representative sample of the suspect feed.

If a veterinarian can initiate treatment immediately after exposure, he or she can also attempt decontamination. However, in most cases the exposure is not realized until after clinical signs have started. There is no antidote for ionophore poisoning, but veterinarians can initiate symptomatic and supportive care. Some horses might die regardless of treatment; others might recover over days, weeks, or months and return to performance; and some will develop permanent heart damage and never recover fully.

Overall, prevention is important. Do not allow horses access to feeds or feed pre-mixes prepared for other species, and purchase all horse feeds from reputable sources that practice good quality control measures. Consider signing up to receive automated feed recall notifications from the FDA (see the FDA Center for Veterinary Medicine website for further information on recall notifications). UK

Cynthia Gaskill, DVM, PhD, clinical veterinary toxicologist at the University of Kentucky Veterinary Diagnostic Laboratory, provided this information. Contact her via phone: 859/257-7912, or e-mail: cynthia.gaskill@uky.edu.

EASTERN TENT CATERPILLAR EGG HATCH UNDER WAY IN CENTRAL KENTUCKY

Experts report that this year's Eastern tent caterpillar egg hatch is about a week ahead of the past 10 years' average.

"By the end of March, all egg masses present should have hatched and larvae should be in the ½- to ¾-inch range," said Lee Townsend, PhD, University of Kentucky (UK) College of Agriculture entomologist. "Small tents—approximately golf-ball sized—should be visible in cherry trees. This will be a good time to begin to assess activity and population size."

Townsend urged horse farm owners to check wild cherry and related trees for Eastern tent caterpillar activity to determine whether management is necessary. If control measures are needed to reduce numbers, property owners should take action before the caterpillars leave their trees.

"The small caterpillars will stay near the egg mass for a short time before moving to feed on expanding leaves," Townsend said.

(EASTERN TENT CATERPILLAR ...)

"Eastern tent caterpillars grow and develop as long as the temperature is above 37 degrees; the warmer it is, the faster they will grow. Cold temperatures will slow them down, but the tent and the general cold hardiness of the species will keep them from being affected drastically, even if temperatures drop below freezing at night," he added.

Controlling Eastern tent caterpillars is vital to area horse farms, as UK research results

WEED OF THE MONTH

Common name: Red Maple
Scientific name: *Acer rubrum* L.
Life Cycle: Perennial tree
Origin: North America
Poisonous: Yes

Red Maple

Red maple is a highly valued tree in managed landscapes in the eastern United States and Canada. These native trees produce brilliant red leaves in the fall, which is a major reason small and large horse farm owners desire them on their properties. Many people plant the trees without realizing their potential toxicity to horses. Red maple leaves are palmate (hand-shaped) with three to five lobes and might be 2 to 6 inches in length; leaves are usually about as wide as they are long. The sides of the central lobe are parallel with each other, and the leaf edges are serrated.

Older, fallen red maple leaves, damaged or wilted leaves, and leaves on pruned stems are most toxic to horses. The toxin is believed to be gallic acid, which might cause hemolytic anemia (a condition in which there are not enough red blood cells in the blood, due to the premature destruction of red blood cells). Generally, horses are at most risk of poisoning from June through October.

To avoid potential toxicity to horses, owners should remove red maple trees from farms. Also, do not allow horses to have access to trees that have been cut. Remember that while landscape specialists might recommend planting red maple trees because of the red foliage and ease of establishment, they might not realize the plants' potential for horse toxicity.

Consult your local Cooperative Extension Service personnel (www.csrees.usda.gov/Extension) for specific identification and control in your area. UK

William W. Witt, PhD, a researcher in the University of Kentucky Plant and Soil Sciences Department, provided this information.

MASTHEAD

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The Horse: Your Guide to Equine Health Care

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(EASTERN TENT CATERPILLAR ...)

indicate the caterpillars caused outbreaks of mare reproductive loss syndrome, which can cause late-term foal losses, early- and late-term fetal losses, and weak foals.

During the 2001-2002 MRLS outbreak, an estimated 30% of that year's Thoroughbred foal crop was lost. The state suffered an economic loss of approximately $336 million in all horse breeds.

Tents are visible in cherry trees.

Following this outbreak, UK researchers conducted epidemiological and field studies demonstrating that MRLS was associated with unprecedented Eastern tent caterpillar populations on Kentucky horse farms. Studies since the outbreak have subsequently revealed that horses will inadvertently eat the caterpillars and that the caterpillar hairs embed into the horses' alimentary tract lining (which runs from the mouth to the large colon). Once that protective barrier is breached, normal alimentary tract bacteria might gain access to and reproduce in sites with reduced immunity, such as the fetus and placenta in pregnant mares. Fetal death from these alimentary tract bacteria is the hallmark of MRLS.

UK entomologists recommend that unless horse farm managers have been aggressive in managing Eastern tent caterpillars or removing host trees, they should keep pregnant mares out of pastures bordered by cherry trees for the next several weeks.

Townsend offered the following recommendations for controlling moderate to large caterpillar populations if horses cannot be moved to avoid possible exposure:

"Foliar sprays for caterpillar control can be made when tents are about the size of a baseball. Another option is the injection of trees with a systemic insecticide by commercial pesticide applicators or arborists. Regardless of the treatment used, it is important to revisit the sites in about five days to assess caterpillar activity," he said. UK

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

POTOMAC HORSE FEVER RESEARCH

Potomac horse fever (PHF), or equine monocytic ehrlichiosis, as it is currently termed, still occurs in areas of the United States. It can often pose a diagnostic challenge because of its varied clinical presentations. Potomac horse fever was first recognized in the early 1980s in the Potomac River area of Maryland. The cause was found to be a microorganism initially named *Ehrlichia risticii*, which has since been renamed *Neorickettsia risticii*.

Much of the early research dealt with investigating how this disease—which is not contagious between animals—is transmitted. Researchers initially discovered that transmission could occur by horses ingesting *N. risticii*-containing flukes that develop within aquatic snails; however, more recently researchers have found that insects, including damselflies, caddis flies, and mayflies, can also harbor the flukes containing the organism, as ingestion of these insects has resulted in PHF. This discovery is significant, since these flying insects can swarm in large numbers and be numerous on pastures. Furthermore, the insects are attracted to lights in stabling areas, increasing horses' risk of exposure. Horses do not have to be in close vicinity to a water source to contract PHF; even dead insects on pasture or in feed or water buckets can pose a risk.

Since August 2009, the University of Kentucky Veterinary Diagnostic Laboratory has diagnosed seven cases of PHF in horses presented for necropsy (Table 1). The primary clinical sign was diarrhea. Additional signs reported included anorexia, toxemia, colic, edema (fluid swelling), ataxia (incoordination), and laminitis. Apart from necropsy cases, the laboratory received blood and fecal material for PHF testing by indirect fluorescent antibody (IFA) and polymerase chain reaction (PCR) methods. From October 2010 through October 2011, the lab tested 238 serum samples for antibodies to the PHF

agent using the IFA method. Of these samples, 89 were positive. The IFA test indicates prior exposure but does not necessarily signify active infection and cannot differentiate natural exposure from a vaccine-induced titer. Paired serum samples two to three weeks later might yield more definitive information.

Additionally, the lab tested 225 whole blood and/or fecal samples using PCR, and 35 samples were positive. The PCR test detects the presence of specific nucleic acid of *N. risticii*, indicating presence of the organism. Both the IFA and PCR tests were performed on 87 cases/samples, of which 12 were positive in both tests. Table 2 depicts the time of year the diagnoses were made, indicating that PHF is a warm-weather disease, as would be expected with an insect-borne disease.

If horses live in an area where PHF is known to occur, it is important to limit possible exposure to the vectors. Owners should consider keeping food covered, using insect control around barns, and restricting grazing near water sources during the warmer months. A vaccine is available, but its ability to protect against infection is not fully established. Horse owners should consult their veterinarians for specific recommendations appropriate to their situation. UK

Neil Williams, DVM, PhD, Dipl. ACVP, is assistant director at the University of Kentucky Veterinary Diagnostic Laboratory. Contact him at 859/257-8283 or nmwillia@uky.edu.

Reprinted from the Equine Disease Quarterly, *UK Department of Veterinary Science.*

TABLE 1.

Potomac Horse Fever necropsy cases. August 2009-October 2011

DATE	AGE	BREED	SEX
August 2009	5 yr	Quarter Horse	male
August 2009	3 yr	Thoroughbred	female
September 2009	5 yr	Quarter Horse	male
July 2010	10 yr	Tennessee Walking Horse	female
June 2011	unknown (adult)	Thoroughbred	female
June 2011	unknown (adult)	American Saddlebred	female
July 2011	9 yr	Thoroughbred	female

TABLE 2.

Antemortem and postmortem Potomac Horse Fever cases by month when diagnosed.

Month[1]	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
IFA[2] & PCR[2] positive	1	3	2	3	3	
PCR[2] positive	1	9	11	7	6	1
Necropsy cases		2	2	2	1	

[1] *Other months had no cases.*

[2] *IFA= indirect fluorescent antibody; PCR= polymerase chain reaction.*

STUDENT SPOTLIGHT

To highlight equine research projects by graduate and doctorate students in the University of Kentucky College of Agriculture, the Bluegrass Equine Digest newsletter features a different student's work in each issue.

Yun Young Go

From: Seoul, Korea

Degrees: DVM, College of Veterinary Medicine, Konkuk University, Seoul, Korea
MSc, College of Veterinary Medicine, Konkuk University, Seoul, Korea
PhD, Department of Veterinary Science, University of Kentucky Gluck Equine Research Center

In December 2011 Yun Young Go completed her doctorate in the Department of Veterinary Science at the University of Kentucky Gluck Equine Research Center under the guidance of Peter Timoney, MVB, PhD, FRCVS, Frederick Van Lennep Chair in Equine Veterinary Science, and Udeni Balasuriya, PhD, MS, BVSc, a professor of virology at the Gluck Center.

"Before joining the graduate program as a Geoffrey C. Hughes scholar, I worked as an equine clinician at Korea Racing Authority (KRA), the sole Thoroughbred racing authority in Korea, where I gained ample knowledge and experience in equine medicine," Go said. "A senior veterinarian from KRA recommended that I contact Dr. Peter Timoney, who graciously agreed to be my PhD advisor. After joining the program, I was fortunate to meet Dr. Udeni Balasuriya, one of the leading molecular virologists in equine virology, who mentored me during my graduate studies at the Gluck Equine Research Center."

Go's PhD research focused primarily on equine arteritis virus (EAV), which causes respiratory and reproductive disease in horses known as equine viral arteritis (EVA). "In particular, I characterized the host-virus interactions by combining contemporary molecular biology techniques and host genomic analysis using genome-wide association study (GWAS)," Go said. "The interaction between the virus and the host is important for viral replication, virulence, and pathogenesis."

Go investigated the interactions of viral structural proteins that determine the host cell tropism. In parallel, the GWAS helped to understand horses' genetic basis of susceptibility to EAV infection. She said a common haplotype associated with the *in vitro* CD3+T lymphocyte susceptibility/resistance to EAV infection has also been identified.

"Understanding how cellular proteins interact with viral RNA or viral proteins, as well as their role in viral infection, allows for better characterization of the mechanisms of EAV pathogenesis and persistent infection in stallions," Go said.

In December 2011 Go was certified as a Diplomate in Virology with the American College of Veterinary Microbiology (ACVM). In January 2012 she joined the laboratory of Kate Ryman, PhD, at the Center for Vaccine Research at the University of Pittsburgh as a postdoctoral scholar to work on arthropod-borne viral diseases. "Specifically, I am studying the virus-host interaction and pathogenesis of Yellow fever virus (flavivirus) and Chikungunya virus (alphaviruses) using mice as a model," Go said. UK

Shaila Sigsgaard is a contributing writer for the Bluegrass Equine Digest.

UK'S HORSE PASTURE EVALUATION PROGRAM ACCEPTING ENROLLMENTS

The University of Kentucky (UK) initiated its Horse Pasture Evaluation Program in 2005, which has since grown along with its number of participants. Sponsored by UK Ag Equine Programs, the program was started as a way to develop stronger ties with Kentucky's equine industry.

The program continues to attract new clients.

The program's goals are to provide detailed pasture management recommendations to horse farm owners and managers; help improve pastureland to increase quality and quantity of pasture as a feed source and reduce the need for stored feeds such as hay and grain; and to assess the potential risk of fescue toxicity of individual pastures to pregnant broodmares. The Horse Pasture Evaluation program has maintained several farms as regular clients while attracting new clients each year.

By the end of 2011 the Horse Pasture Evaluation Program had conducted more than 100 evaluations, representing more than 16,000 farm acres in 16 counties across the state. Along with county agents and extension programs and field days, the Horse Pasture Evaluation Program is a valuable tool to help horse farm managers and horse owners make better pasture management decisions.

The program will continue offering two packages in 2012: a small farm option for horse farms and a complete evaluation option for larger farms. Both are available statewide.

For more information or to enroll in the Pasture Evaluation Program, visit www.uky.edu/Ag/forages and click on "horse links." Direct questions to Krista Cotten at 859/257-059, krista.cotten@uky.edu; or Tom Keene at 859/257-3144, tom.keene@uky.edu. UK

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

EQUINE CAREER FAIR

More than 160 college students attended the fourth annual Equine Career Fair, held March 6 and co-hosted by the University of Kentucky Ag Equine Programs and Georgetown College's Equine Scholars Program. Exhibitors representing more than 30 area organizations participated in the event and provided career information and networking opportunities. The Career Fair also featured interest sessions with industry leaders in the areas of veterinary medicine, pharmaceuticals, breed associations, and the Thoroughbred industry. Students from the University of Kentucky, Asbury University, Midway College, Morehead State University, and the Kentucky Equine Management Internship program participated and gained valuable networking experience.

Equine Showcase Presents Young Horse Research

The UK Equine Showcase held Jan. 20 focused on young horse health; here is some research presented during the course:

ANNE M. EBERHARDT

The UK Equine Showcase addressed infectious diseases, deworming, and vaccination of young horses.

Common Infectious Diseases of the Young Horse

Young horses are more susceptible to infectious diseases because of the nature of the equine placenta: No maternal antibody is transferred directly to the foal *in utero*, according to David Horohov, PhD, William Robert Mills chair and professor at the University of Kentucky Gluck Equine Research Center.

A foal's cell-mediated immune system is known to be competent, but naïve, said Horohov. Foals are born with an immature immune system that develops to produce antibodies on its own over time. The foal's initial ingestion of colostrum (the mare's antibody-rich first milk) allows for passive transfer of immunoglobulins, which provide almost immediate immunity against various infections, all dependent upon quantity and quality of maternal antibodies.

"But, foals do not approach adult (antibody) levels prior to about 3 months old," Horohov said.

In most cases, foals that don't receive adequate colostral antibodies from the mare are uniquely susceptible to infectious agents, he explained. A failure of passive transfer is not always obvious since the foal does not exhibit any clinical signs until weeks later. Thus, Horohov recommends breeders keep an eye on the neonatal foal and make sure he obtains healthy antibody levels within the first 12 hours.

"Besides adequate colostrum, vaccination of the mare prior to pregnancy is probably the best protection against viral and bacterial infections in foals, until it's capable to develop antibodies on its own later in life," Horohov said. "Foal mortality is a significant problem for the equine industry, and infectious disease plays a major role in this matter."

According to a study performed in Central Kentucky, the primary causes of foal mortality from birth to 9 months old in two-thirds of all foals were infectious diseases such as septicemia (bloodstream infection), gastrointestinal disease, and/or respiratory disease. The majority of sepsis cases and deaths occur in the youngest foals, according to Horohov, which suggests the illness is likely related to birth. Septicemia is a systemic disease associated with bacteria in the blood spreading to the central nervous system, other organs, bones, and joints. Bacteria are normally present in the foal's environment, but occasionally they invade the foal and take advantage of his immature immune system. Some of the dominant bacteria involved in foal septicemia are *Escherichia coli* (32%), *Salmonella* (11%), *Klebsiella* (7%), *Enterococcus* (2%), and *Actinobacillus* (7%).

(EQUINE SHOWCASE ...)

Diarrhea "Foal diarrhea is one of the most common (foal) illnesses and probably the most difficult to deal with," Horohov said.

The causative agents for foal diarrhea range from bacteria to viruses to parasites. He said a lot of cases likely go undiagnosed. Agents causing foal diarrhea include rotavirus, *Clostridium, Salmonella*, and the parasite *Parascaris equorum*. While most foals carry clostridial bacteria, it is yet unknown why only some foals develop severe diarrheal disease. The role their immune system plays in preventing this disease is unknown.

Respiratory Disease Signs of foal respiratory disease vary from the occasional snotty nose to bronchopneumonia depending on the severity of the respiratory problem, Horohov explained. The agents involved are typically viruses such as equine herpesvirus, (EHV-1, EHV-4, EHV-2), equine adenovirus, equine rhinovirus, and equine influenza. These infections result in acute febrile infection and typically resolve after a few days. Bacterial agents such as *Rhodococcus equi, Streptococcus equi, Actinobacillus, Salmonella, E. coli,* and *Klebsiella* are typically more severe and last longer. These infections require therapeutic intervention and can be life-threatening if not treated promptly.

One of the main causes of respiratory disease in foals is the hardy bacterium *R. equi*, which commonly causes pneumonia. Half the causes of foal mortality from 1 to 6 months old are associated with bacterial agents such as *R. equi*, *Salmonella*, and *Streptococcus equi* spp., whereas one-third are associated with viruses. Foals younger than 6 months are susceptible to *R. equi*, and foals younger than 3 months are at even higher risk.

Infectious disease prevention in foals depends upon multiple factors such as:

Housing: Population density, commingling, fresh air, bedding, disinfection, and sanitation

Weather: Extreme temperatures, humidity, and pollution

Nutrition: Nursing problems, feed quality, and hydration

Handling: Transportation, exposure to new horses, weaning, handling, and antibiotic use

Prevention: Colostrum, vaccination, deworming, and biosecurity

"The tricky part is that they might have become exposed and infected before 2 weeks old, and the initial clinical signs of disease typically manifest several weeks later. The peak in disease in young foals likely occurs when maternal antibodies derived from the mare decline," Horohov said.

According to Horohov, numerous studies have demonstrated foals are deficient in their production of interferon-gamma (IFNγ) in comparison to the mature horse. Researchers have proposed that foals are born with an inherent inability to mount a Th1-based cell-mediated immune response that might contribute to their susceptibility to intracellular pathogens such as *R. equi*.

"We do not yet fully understand the underlying mechanism responsible for this deficiency," he said.

Horohov and his colleagues previously examined whether common immunostimulants could accelerate the young foal's ability to produce IFNγ to better fight infections. Resistance to this disease appears to be associated to IFNγ production.

"We were able to measure increased levels of IFNγ after 14 days, whereas earlier on in life they seemed incapable to respond to the stimulants," Horohov said.

This indicates that a foal's ability to produce IFNγ increases with age. He said the risk for infectious disease in the foal is likely to be a combination of immune status, environmental factors, and farm management. All factors play a significant role, and prevention might be the best choice to decrease the risk of infectious disease.

Vaccination Strategies and Immunity

Many serious infectious diseases occur early in life, and vaccination, along with management measures, remains the primary method for effective infectious disease control.

Amanda Adams, PhD, assistant professor at the University of Kentucky Gluck Equine Research Center, said young horses should be vaccinated to help prevent disease, induce immunity, and reduce disease severity and spread.

(EQUINE SHOWCASE ...)

The goal of any vaccination program is to induce immunity, which is a state of having sufficient biological defenses to avoid infection, disease, or other unwanted biological invasion. The three types of immunity are natural acquired immunity (induced by infection), artificially acquired immunity (induced by vaccination), and passive acquired immunity (provided to the foal via colostrum).

Vaccinating the foal in the face of maternal antibody As mentioned, the neonatal foal is born with a naive immune system, but inherits immediate protection through the vaccinated mare's colostrum, Adams said. The mare's initial maternal antibodies decline over time, subsequently leaving the foal uniquely susceptible to a variety of infectious diseases. Depending on the quantity and quality of maternal antibodies the mare passes to her foal, the duration of protection varies widely.

"Make sure not to interfere in the face of maternal antibodies or leave the foal unprotected after the waning of material antibodies," Adams said. "Foals need to develop adequate immunity against viral and bacterial infections in the environment. This makes it somewhat challenging to pinpoint the timing of the foal's first vaccination, since you will need to know the duration of the maternally derived antibodies in order to start a foal vaccination regime."

According to Adams, vaccinating foals can be associated with a number of difficulties due to their limited cell-mediated immune response to the currently available vaccines. She said researchers have observed in numerous studies that if maternal antibodies are still circulating at a high level in the foal, they can block the foal's response to multiple types of equine influenza vaccines.

Results from a 2001 study revealed that 3-month-old foals did not show increases in antibody titers against either influenza or tetanus subisotypes in response to two vaccine doses. They generally needed one to three additional booster doses of vaccine to achieve titers similar to those achieved by yearlings after two doses. Further, all three groups of inactivated, live, or vectored recombinant vaccines failed to overcome maternal interference of antibody production, Adams said.

"They are simply immunologically unresponsive until later in life," she said.

It has been proposed that during pregnancy mares produce factors that inhibit cell-mediated responses in order to prevent fetal rejection, Adams said, eventually causing delayed cell-mediated responses in the foal. However, the underlying mechanisms responsible need further investigation.

Weaning is considerably stressful for foals, both physically and mentally. Results of several studies in other species emphasize weaning's impact on the effect of lowering cell-mediated immunity; however, little is known about this in foals. Adams recently performed a study measuring cellular immunity following abrupt weaning in foals. Her results showed a significant reduction in cytokine production, which is important for fighting pathogens.

"Vaccination in the face of weaning stress may not be the best timing to induce an immune response. But, further studies are needed to determine the right time," Adams said. "Always minimize the weaning-associated stress, which might help limit the impact that weaning has on the immune response."

A vaccination regime for the foal depends on the mare's vaccination status, the foal's age, geographic location, and foals' and weanlings' exposure levels. Adams advised consulting a veterinarian for a tailor-made vaccination strategy, since foal immunity is based on both exposure and protection.

Multiple vaccines are available and have both advantages and limitations. Moreover, different vaccine classes stimulate the immune system in very different ways. Three types of vaccines:

Inactivated vaccines (short-term protection, induce a strong antibody response)

Live vaccines (cross-reactive, longer term protection, induce both antibody and cell-mediated immune responses)

Vectored vaccines (recombinant, longer term protection, induce primarily cell-mediated immunity with some antibody response)

(EQUINE SHOWCASE ...)

Core vaccinations for foals include Eastern and Western encephalitis (EEE and WEE) viruses, West Nile virus, tetanus, and rabies. If foals are exposed to other horses, they should also receive vaccination against equine herpesvirus types 1 and 4 as well as equine influenza virus (EIV).

When vaccinating against EIV, maternal antibodies can persist until 6 months old and prevent immune responses in foals vaccinated prior to reaching that age, so it is especially important to wait before administering the vaccine to foals. many veterinarians recommend foals begin vaccinations at 3 to 4 months, followed by one to two boosters at four-week intervals.

Mares should receive a booster vaccine one to two months prior to parturition, which induces antibody responses that are then passed on the foal via colostrum. Typically this includes vaccinations for tetanus, encephalomyelitis viruses, influenza virus, and rhinopneumonitis virus, with additional vaccinations for *Streptococcus equi*, Potomac horse fever, and in some circumstances botulism, depending on exposure level and geography, among other factors.

Deworming Strategies

The foal and the juvenile horse belong to the age groups that should be given the most attention in terms of parasite control. These groups are particularly susceptible to parasitic infection, because unlike older horses they do not yet have acquired immunity to some types of parasites. Martin Nielsen, DVM, PhD, Dipl. EVPC, assistant professor at the University of Kentucky's Gluck Equine Research Center, recommends designing a parasite control program for foals and young horses with the goal of avoiding parasitic disease, reducing the rate of drug resistance development, and allowing horses to develop acquired immunity.

"In order to design a reliable parasite control program, we need knowledge about two key issues—your drugs and your parasites," Nielsen said. "There might be huge differences from farm to farm when it comes to drug efficacy, and it should be born in mind that different parasites are present simultaneously. To avoid parasitic disease with manifestations such as stunted growth, diarrhea, and colic, you will need to achieve information on the efficacy of drugs used on your farm. We still want to have efficient drugs available in the future for the 'wormy' foal."

2-3 months old: Roundworm treatment

6 months old (weaning): Take a fecal sample—roundworm or strongyles? Choose drug accordingly. Take another fecal sample 14 days post-treatment—did it work?

9 months old (spring): Primarily strongyles—use efficient drugs

12 months old (spring/summer): Primarily strongyles—can be combined with tapeworm treatment

1-4 years old: Typically three annual treatments: spring, summer, and fall. Tapeworm treatment once or twice yearly

According to Nielsen, running fecal egg counts is the cornerstone of an up-to-date parasite control program. On this basis, he recommends foal owners perform a few egg counts to determine the exposure level of ascarids and strongyles.

"It's useful information to know when ascarids are actually kicked out and the strongyles are taking over as well as to monitor the ongoing efficacy of the drugs 14 days after the initial treatment of the foals," Nielsen said.

So what happens during the first year of the horse's life? There is a distinct timeline in terms of which parasites a horse is exposed to as he grows up, Nielsen said.

He added that breeders should pay particular attention to the ascarid parasites (large roundworms), as they are considered the most pathogenic in foals.

Strongyloides westeri (threadworm), a mildly pathogenic parasite, is uniquely capable of reproduction in the environment, whereas most other parasites reproduce in the horse, Nielsen said. Parasite infection is transmitted in three possible ways: lactogenic transmission (larvae are passed from mother to foal through the milk), the fecal-oral route (infective larvae are ingested while grazing), and the transdermal route (the larvae penetrate the skin of the horse and enter the bloodstream).

(EQUINE SHOWCASE ...)

"We rarely see any parasitic disease associated with this parasite, and it occurs almost entirely in the very young foal. This suggests that the foal builds up a strong immunity a few weeks after birth," Nielsen said. "The good news is that we don't have any signs of drug resistance. The tradition has been to treat mares prior to parturition, but it's questionable whether treatment prior to foaling is needed if mares are well-maintained."

"*Parascaris equorum* (large roundworm) is the most important parasite in foals less than six months of age, with a prevalence of 80% to 100%," Nielsen said.

Know your drugs: Perform fecal egg counts to monitor the ongoing drug efficacy; rotation does not work.
Know your parasites and the exposure level on your farm: Different parasites require different drugs.

After being ingested by a foal, the infective roundworm eggs release their larvae in the small intestine, and the larvae subsequently migrate quite extensively within the body. They travel to the liver and lungs where they might cause airway symptoms.

"It has been suggested that this extensive migration could explain the strong immunity, which apparently kicks in at about 6 months of age," he said. "Take a fecal sample about the time of weaning. This will provide you with information on when these ascarids disappear and the strongyles take over."

This is important because it affects dewormer choice, he added. Large numbers of roundworms can lead to intestinal impaction, which is associated with a reserved prognosis for survival.

"Timing and correct choice of drugs, therefore, should be the key focus in any ascarid control program," said Nielsen. "Frequent treatment with four to six intervals has been the tradition leading to widespread resistance to ivermectin and moxidectin. Foals 6 months old and older have started encountering strongyle parasites, which can be divided into two main groups of the 100% prevalent small strongyles (cyathostomins) and the large strongyles.

"The strongyle parasites will accompany the horse for the rest of his life," he continued. "Large strongyles are considered far

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the most pathogenic parasite, but they have become very rare in managed horse populations."

Younger horses tend to have larger worm burdens and shed more strongyle eggs than the mature horse, but horses of all ages harbor cyathostomins, Nielsen noted.

"This could suggest that the immunity to strongyles is fairly limited," he said. "We see widespread evidence of resistance to benzimadoles, emerging levels of pyrantel resistance, as well as beginning signs of ivermectin and moxidectin resistance. The good news is that we still have no signs of resistance in large strongyles," Nielsen said.

The fourth parasite foals encounter is the ubiquitous tapeworm, also known as *Anoplocephala perfoliata* (flatworm). Usually it occurs during the same time period as the strongyles. Tapeworms are flat, segmented worms transmitted to the horse by ingesting an intermediate host—oribatid mites—infected with the tapeworm.

"Because this parasite is uniquely dependent on the oribatid mite, only horses located in areas where these mites are present on pasture are at risk for tapeworms," Nielsen said.

Farm prevalences often vary in the range of 20-80%. The parasites stay in the horse's intestine attached to the wall and might cause impactions, intussusceptions (where the intestine telescopes back onto itself), or spasmodic colic, but infection often goes unnoticed.

"So far, there are neither established treatment traditions for this parasite nor reports of drug resistance. We don't yet have efficient methods available to measure drug resistance in tapeworms," Nielsen said. "I would recommend an initial tape worm treatment from about 12 months of age, and it should be considered in combination with strongyle treatment based on a modified egg or a serum antibody measurement (ELISA) in spring and summer." UK

Shaila Sigsgaard is a contributing writer for the Bluegrass Equine Digest.

LEADERSHIP STRAIGHT FROM THE HORSE'S MOUTH

Local leaders in various areas of the equine industry will explore how the horse influenced their personal leadership development and career paths during a public panel discussion April 17 in the University of Kentucky Veterinary Diagnostic Laboratory auditorium.

Hosted by the UK College of Agriculture's Center for Leadership Development, the evening's activities will start at 6:30 p.m. EDT with a reception with the panelists. The discussion will begin at 7 p.m., featuring horse training professional Avo Kiviranna, chair of Midway College's Equine Studies Division; Harold Rainwater, founder and director of the equine program at Asbury University and the mayor of Wilmore; Ed Squires, PhD, Dipl. ACT (hon.), director of UK Ag Equine Programs and executive director of the UK Gluck Equine Research Foundation; Sara Tracy, community liaison for Locust Trace AgriScience Farm; and Patricia Cooksey, director of public relations for the Kentucky Horse Racing Commission and the first female jockey to win a stakes race at Churchill Downs.

The Center for Leadership Development, under the direction of Tricia Dyk, PhD, currently facilitates Equine Guided Leadership Education workshops for both students and the public, during which they explore ways horses teach people leadership competencies.

"We hope these leaders' stories will inspire students who are interested in careers in the horse industry," said Lissa Pohl, MS, program and outreach associate for The Center for Leadership Development.

The event is sponsored by the W. Norris Duvall Leadership Education Fund, whose mission is to support the leadership development of young college and college-bound students by exposing them to community leaders who exemplify character and values.

There is no fee to attend, and parking is available at the event. UK Veterinary Diagnostic Laboratory is located at 1490 Bull Lea Road, off Newtown Pike in Lexington. For more information, contact Pohl through e-mail: lissa.pohl@uky.edu. UK

Carol Spence, Agricultural Communications Specialist in the College of Agriculture and Editor of The Ag Magazine, *and Lissa Pohl, MS, program and outreach associate for The Center for Leadership Development, provided this information.*

EQUINE DRUG TESTING AND THERAPEUTIC MEDICATION REGULATION BOOK RELEASED

Wind Publications released the fourth edition of "World Rules for Equine Drug Testing and Therapeutic Medication Regulation" on Feb. 14 and has sold more than 100 copies. Thomas Tobin, MVB, MSc, PhD, MRCVS, Dipl. ABT, professor at the University of Kentucky Gluck Equine Research Center; Kimberly Brewer, DVM, a private practitioner; and Kent Stirling, executive director of the Florida Horsemen's Benevolent and Protective Association authored the 286-page book.

The newly released fourth edition covers worldwide medication rules for the first time and features a forward written by Kentucky First Lady Jane Beshear. The book addresses specific regulatory procedures in place around the world to regulate the use of therapeutic medications and endogenous, dietary, and environmental substances in racing and performance horses. The book is based on the Association of Racing Commissioners International (ARCI) classification system for foreign substances and lists many of the specific regulatory thresholds/withdrawal time guidelines in place for the approximately 99 such substances—from acepromazine to xylazine—in use around the world.

Some widely used therapeutic medications are associated with an unusually high risk of inadvertent identifications or overages; these substances are marked with a Horsemen's Alert, which sets forth the reasons for the alert and suggests avoidance actions. Additionally, and somewhat unusually, three substances are listed with Chemist's Alerts, with explanations provided.

Regulatory thresholds are defined as plasma or urinary concentration of drugs/drug metabolites and are the essential regulatory tools. What the horseperson needs, however, are withdrawal time guidelines: simple, unambiguous medication administration guidelines scientifically linked to the regulatory threshold and which serve to greatly reduce the probability of a therapeutic medication "overage." Appendix 1 of the book reviews the critically important matter of withdrawal time guidelines and details the factors influencing withdrawal time guidelines.

Many horse people are unfamiliar with the language of equine forensic science. Appendix 2, therefore, presents the language, definitions, and

KIDS BARN GRAND OPENING

On March 7 the Kentucky Horse Park hosted a grand opening of its new Kids Barn, an interactive group of displays geared toward children under 13 years old. The park repurposed one of its draft horse barns for the educational display area, with each of the 20 stalls that once housed horses now featuring educational and interactive equine displays. UK Ag Equine Programs' display, called "Exploration Station: Science and Discovery," features information about the Kentucky 4-H Horse Program, body condition scoring, hay and forages, parasites—with actual jars of worms—and how horse and human skeletons are similar. UK's partnership program, Saddle Up Safely, is an educational resident as well and offers interactive education on horse riding safety.

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abbreviations used. Appendix 3 lists the equine therapeutic medications identified by the American Association of Equine Practitioners and by the Racing Medication and Testing Consortium, ntoign that the therapeutic medication status of some of these substances is under review. Appendix 4 sets forth the need for suitable reference standards for therapeutic medication regulation and outlines national and local Horsemen's Benevolent and Protective Associations' (HBPAs) contributions in this critically important area of forensic science. Appendix 5 lists the HBPAs that have supported these research efforts, and the book closes with Appendix 6, a list of scientific references.

The book can be purchased on Amazon at www.amazon.com/Equine-Testing-Therapeutic-Medication-Regulation/dp/1936138425/ref=sr_1_fkmr1_1?ie=UTF8&qid=1329331893&sr=8-1-fkmr1. UK

Thomas Tobin, MVB, MSc, PhD, MRCVS, Dipl. ABT, professor at the University of Kentucky Gluck Equine Research Center, provided this information.

UPCOMING EVENTS

March 29, 4 p.m.
Department of Veterinary Science Equine Diagnostic Research Seminar Series; Jim Belknap, DVM, PhD, Dipl. ACVS, from Ohio State University, will speak about laminitis. Veterinary Diagnostic Laboratory, Lexington, Ky.

March 31, 9 a.m.-5 p.m.
4-H Basic Horsemanship Clinic, Alltech Arena, Kentucky Horse Park, Lexington, Ky.

April 14
4-H State Judging Contest, Kentucky Expo Center, Outdoor Covered Arena, Louisville, Ky.

April 16, 2 p.m.
Gluck Foundation Spring Board Meeting, Culton Suite, E.S. Goodbarn, Lexington, Ky.

April 17, 6 p.m.
UK Horse Racing Club's "Inside Horse Racing Panel: The Road to the Triple Crown," Fasig-Tipton Sales Pavilion, Lexington, Ky. Horse Racing Radio Network's Mike Penna is the master of ceremonies. Confirmed speakers to date include Team Valor's Barry Irwin, Thoroughbred trainer Dale Romans, and Triple Crown winner Seattle Slew's jockey Jean Cruguet. The designated charity for the evening is the Permanently Disabled Jockey's Fund. Tickets are $5 for students and $10 for the general public. Parking is free.

April 17, 6:30 p.m.
Leadership Straight from the Horse's Mouth, Veterinary Diagnostic Laboratory, Lexington, Ky.

April 19
Shelbyville/Louisville Kentucky Equine Networking Association (KENA) meeting, Location TBD

April 16, 4 p.m.
Department of Veterinary Science Equine Diagnostic Research Seminar Series; Kent Allen, DVM, from Virginia Equine Imaging will speak about lameness and diagnostic imaging. Veterinary Diagnostic Laboratory, Lexington, Ky.