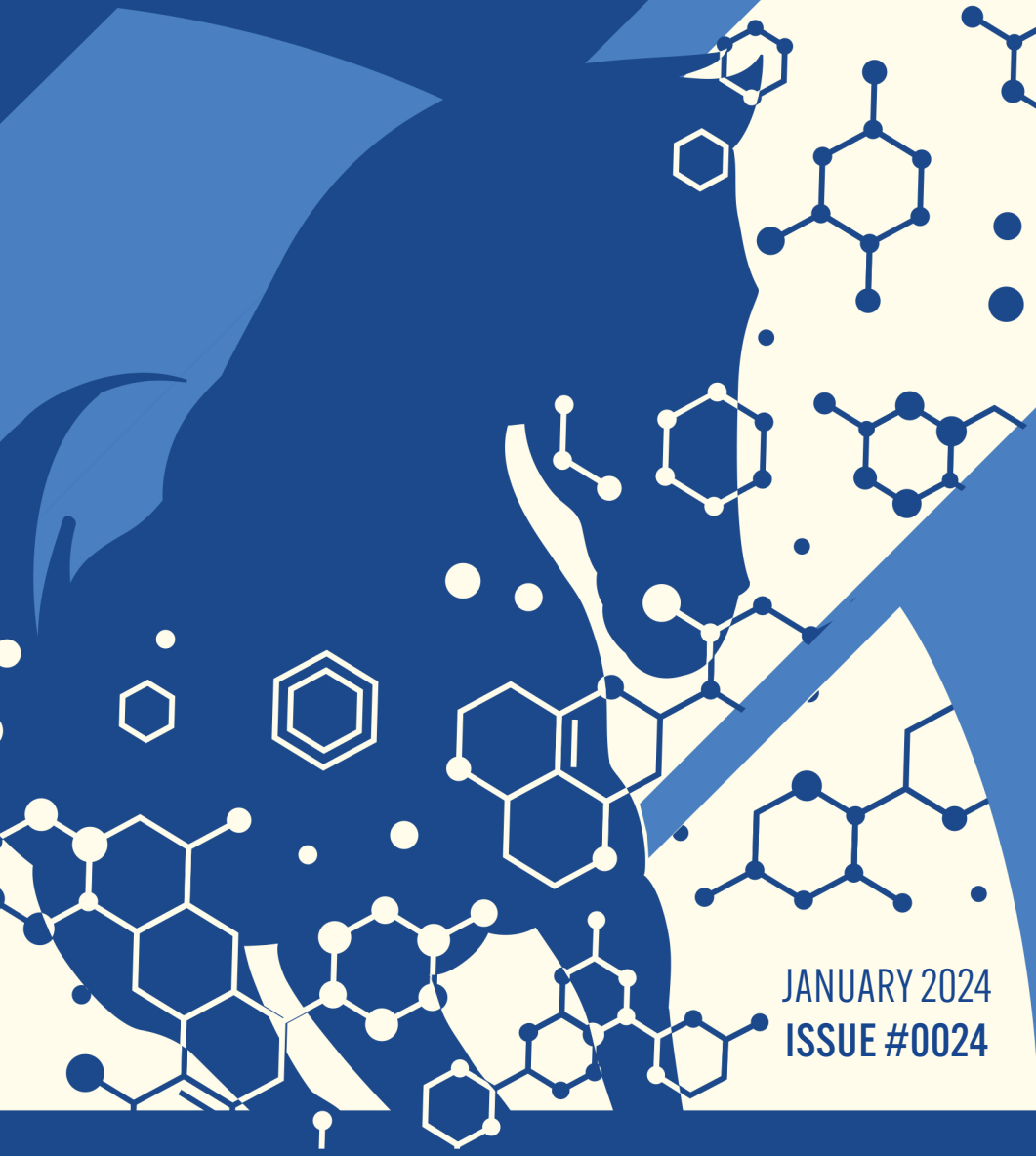


EQUINE SCIENCE REVIEW



[CA.UKY.EDU/EQUINE](https://ca.uky.edu/equine)
[@UKAGEQUINE ON FACEBOOK/X](https://www.facebook.com/ukagequine)

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ISSUE #0024

ESR

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Equine Science Review is a monthly Martin-Gatton College of Agriculture, Food and Environment newsletter that highlights important equine work happening at the University of Kentucky.



Photo courtesy Dr. Jimmy Henning.

WELCOME BACK TO THE EQUINE SCIENCE REVIEW!

Note from the editor: Welcome to the Equine Science Review: highlighting research and outreach efforts at the University of Kentucky! The Review is back and better than ever! This monthly newsletter from the University of Kentucky Martin-Gatton College of Agriculture, Food and Environment highlights the important equine work happening at the university.

UK is home to world-class research and service excellence in equine health, safety, nutrition, pasture and forages, economics, engineering, environmental compliance and many others. Programs at UK offer the depth and breadth of scope fitting its location in the heart of horse country.

Have updates delivered to your inbox each month by subscribing to the Review at <https://mailchi.mp/uky/equinesciencereview>.

17TH ANNUAL PASTURES PLEASE!! SET FOR MARCH 5

Amid Kentucky's winter season, equine enthusiasts and farm operators are already shifting their focus to the upcoming springtime pastures. The University of Kentucky Cooperative Extension Service (CES) effort is set to present "Pastures Please!!" March 5 in Georgetown, Kentucky. The event is dedicated to the latest insights in equine pasture management.

"We want to help producers best utilize the resources they have on hand to manage their particular farming operation more sustainably and profitably," said Beau Neal, Woodford County agriculture and natural resources agent. "Many of the topics discussed each year can be put into practice and be beneficial to these farms in more ways than one."

This year, UK Martin-Gatton College of Agriculture, Food and Environment experts will cover a range of topics, including the strategic use of herbicides in effective weed control, rescuing pastures for short-term use and strategies for fertilizing pastures.

"County agents have worked hard developing a program, addressing what could impact pastures in the upcoming grazing season," said Bob Coleman, PhD, Animal and Food Science associate professor. "While the conditions change from year-to-year, county agents are observing what their clients need regarding their pastures. It continues to be a strong educational resource for horse owners."

Pastures Please!! was initiated in 2007. It was developed by CES agents to deliver relevant and actionable information to horse owners.

The program takes place from 5:30 to 8 p.m. EST at the Scott County Cooperative Extension office. Attendees can register for this complimentary session at www.tinyurl.com/pasturesplease or contact the Scott County office by email at scott.ext@uky.edu or phone at (502) 863-0984 for further details. The Scott County extension office is located at 1130 Cincinnati Road in Georgetown, Kentucky.

| *Jordan Strickler is an agriculture communication specialist in UK's Martin-Gatton College of Agriculture, Food and Environment.*



PHOTO COURTESY UK MARTIN-GATTON COLLEGE OF AGRICULTURE, FOOD AND ENVIRONMENT.

Objectives

1. Evaluate the use of care systems and relationships to chronic pain
2. Assess changes in psychosocial factors across a semester



Team A: Direct Athletic Trainer Access



Team B: No Direct Access to an Athletic Trainer

Methods

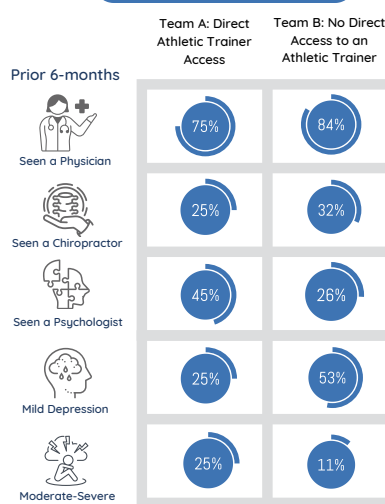
Spring 2023 Academic Semester Survey: Baseline + every 2-weeks with PHQ-9, GAD7, PSS and Equestrian-specific injury and stress questions. General Linear Model analysis with access to care and injury history as variables of interest.

Population



n = 39 healthy female equestrian athletes, 19-23 years old

Baseline Findings



Key Messages



Having access to a dedicated athletic trainer was associated with greater strength, cardiorespiratory, and cognitive focus attributes.

Injury to the lower extremities was equal to or higher than reported concussions, suggesting injury awareness should expand beyond concussion.



Access to an athletic trainer may improve concussion injury reporting.

Recognizing the relationships between prior injury and perceived stress are important to building care systems for equestrian athletes.



The project described was supported by the NIH National Center for Advancing Translational Sciences through grant number UL1TR001998. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH. January 30, 2024

The infographic above is a follow-up to a study conducted in Fall 2023 on how access to care affects management of chronic pain and injury among collegiate equestrians.

According to a survey conducted by Kimberly Tumlin, PhD, research assistant professor evaluating horse-human interaction science in the for the Center in Innovation in Public Health and in the Department of Athletic Training and Clinical Nutrition (College of Health Sciences), almost half the members of a University of Kentucky equestrian team have suffered a suspected concussion and more than half experience chronic pain.

With funding from the Central Appalachian Regional Education and Research Center (CARERC), Tumlin sought to gauge the extent to which collegiate equestrian teams' access to medical care and patient involvement helps manage chronic pain and injury. As part of her study, she collected and analyzed data on two teams: the University of Kentucky Hunt Seat Team, which is not required to provide direct access to health care following an injury, and the Sweet Briar College (Virginia) Hunt Seat team, which is required to provide such access to care. Tumlin expects to find that equestrian athletes with direct access to care systems will have less chronic pain than those without.

The objectives of Tumlin's study were to evaluate equestrians' use of care systems they have access to, track changes in equestrians' psychosocial status (experiencing depression and anxiety) after injury and compare differences in social support of the UK and Sweet Briar teams.

The study included 39 total healthy female athletes participate (5% Hispanic, 87% White, 10% Asian, non-Hispanic). The majority were in their second and third years of college. The majority of riders had more than 10 years of experience.

Read more about the study [here](#).

| Kimberly I. Tumlin, PhD, MS, MPH is a faculty member in the Center for Innovation in Population Health; assistant professor, Athletic Training and Clinical Nutrition, College of Health Sciences; and research director, Equestrian Athlete Initiative.

UK EQUESTRIAN TEAM MEMBERS PARTICIPATED IN THE STUDY INCLUDED TEAM MEMBER ALLISON KROPH, HELPING WITH UK HORSES AT NATIONALS, LEFT, AND GEORGIA MURRAY, THEN STUDENT PRESIDENT OF THE UK HUNT SEAT TEAM, RIGHT. PHOTOS PROVIDED BY STUDY PARTICIPANTS.



GET STARTED IN THE HAY BUSINESS AT THE KENTUCKY ALFALFA AND STORED FORAGE CONFERENCE

The Kentucky Alfalfa and Stored Forage Conference 2024, hosted by the University of Kentucky Martin-Gatton College of Agriculture, Food and Environment Forage Extension Program and the Kentucky Forage and Grassland Council, invites all alfalfa, forage and hay producers.

The daylong conference runs 8 a.m. to 3:15 p.m. CST, Feb. 8 at the Warren County Extension Office in Bowling Green.

Themed “Getting Started in the Hay Business,” the annual conference aims at improving producers’ hay yield and production, marketing and promotion. UK forage specialists, Kentucky farmers, alfalfa producers and other industry speakers will offer information and inspiration on this valuable Kentucky commodity.

“This is the premiere event to learn from successful alfalfa and hay producers, extension agents and other leaders to take your business to the next level,” said Christopher Teutsch, Martin-Gatton CAFE extension associate professor and forage specialist. “Soil and grass are the most important with hay production. We want to help producers better understand their grass and achieve higher quality hay.”

Centered around all things alfalfa, hay and storage and forage species, specific event topics include operating a hay and straw farm, teaching hay buyer’s equine nutritional requirements, finding and evaluating equipment, fertilizing basics, getting started in the hay business and more.

During the panel discussion, hay and alfalfa producers will highlight their specialization and pathways to successfully starting a business. Additionally, the con-



PHOTO COURTESY UK MARTIN-GATTON COLLEGE OF AGRICULTURE, FOOD AND ENVIRONMENT.

ference will include lunch, awards, exhibits and a silent auction.

Individuals may preregister for the conference at the Kentucky Alfalfa and Stored Forage Conference Eventbrite site or visit <https://2024ASFConference.eventbrite.com>.

Registration is \$40 for general admission or \$15 for students. Mail registration and checks can be made payable to KFGC to Caroline Roper, PO Box 469, Princeton, KY 42445. For more information, contact Roper at 270-704-2254 or email at caroline.ropер@uky.edu.

Registration and sponsorships are available until Feb. 8, including on-site.

| *Christopher Carney is the associate director of communications with the Martin-Gatton College of Agriculture, Food and Environment.*

UPCOMING EVENTS

Kentucky Alfalfa and Stored Forage Conference, Warren County Extension Office, Bowling Green, Feb. 8, <https://2024ASFConference.eventbrite.com>

Pre-Veterinary Experience Day, Kentucky Horse Park, Feb. 17, <https://www.eventbrite.com/e/pre-veterinary-experience-day-registration-735882573587?aff=oddtcreator>

Pastures Please!!, Scott County Cooperative Extension Office, Georgetown, Kentucky, March 5, 5:30-8 p.m., www.tinyurl.com/pasturesplease

EQUINE ROTAVIRUS - A 2023 PERSPECTIVE

Since the discovery of equine rotavirus B (ERVB) by the University of Kentucky Martin-Gatton College of Food, Agriculture and Environment's Department of Veterinary Science in 2021, research has been ongoing to develop tools to protect foals against infection. The equine industry has answered the call for financial help, and, along with internal funds from the university, a substantial amount was raised to push forward on vaccine development and antibody synthesis strategies.

Rotavirus is highly contagious with extrapolated data suggesting that only hundreds to thousands of infectious virus particles are needed to infect susceptible foals. This makes biosecurity a challenge. Measures that farms have employed to break the cycle in an outbreak or prevent infection include foaling outside with personnel wearing personal protective equipment, minimal handling of the foal for the first week of life other than the customary 'foal exam' at 12-24 hours of age and rigorous observance of staff/traffic/horse movement in the foaling barn. Links to additional resources are included below. Control of infection during an outbreak is a considerable challenge, emphasizing the need for a protective vaccine.

One significant hurdle in the development of ERVB-directed treatment and prevention tools is the inability to grow the virus in a laboratory. The currently available equine rotavirus A (ERVA) G3[P12] vaccine was developed from a cell-adapted strain of ERVA. This vaccine has made neonatal ERVA extremely rare when foals are born to appropriately vaccinated mares.

The reason why ERVB replicates robustly in foals but has not been able to be grown in the laboratory remains elusive. This is currently under extensive investigation at the Li-Wang Lab at UK's Gluck Equine Research Center.



PHOTO COURTESY UK MARTIN-GATTON COLLEGE OF AGRICULTURE, FOOD AND ENVIRONMENT.

The importance of cell-specific surface molecular patterns in pathogen and cancer biology research has been increasingly demonstrated. Recent work on specific cell surface markers recognized by different rotaviruses has demonstrated that ERVA and ERVB recognize different cell surface markers with varying affinity. While ERVB does not recognize or interact with the same cell surface glycoproteins as ERVA, promising work has identified molecular elements of cell surface markers for which ERVB has a higher affinity. These affinities for specific cell surface markers may be used as a screening tool to identify additional cell line candidates in which ERVB could be propagated in the laboratory going forward.

While ERVB cannot yet be grown in the laboratory, vaccine technology has significantly improved since the first equine rotavirus vaccine was developed in the early 1990s. As a result, the need to grow ERVB in the laboratory to generate a vaccine is no longer the insurmountable barrier it once was, and several alternative vaccine platforms are currently being explored. Indeed, COVID-19

catapulted vaccine development forward by decades and veterinary medicine is now benefiting from that technology.

Vaccine platforms, such as the insect virus baculovirus, can be used as a means to deliver specific components to elicit an immune response, while also being safe for the animals that receive it. Other vaccine technologies, such as mRNA, virus-like particles and expressed protein antigens also show huge promise for the veterinary field. In addition to new antigen formats, the addition of lipid-based nanoparticle adjuvants has improved the effectiveness of modern vaccines considerably compared to older products. These adjuvants are changing the landscape of vaccine development, which may ultimately result in lower antigenic loads (lower quantities of viral components) per vaccine and longer intervals between vaccinations.

Currently, the University of Kentucky is testing the immunogenicity and safety of four ERVB vaccine candidates; results of these studies will be made available as soon as possible. Given that ERVB was only recognized three

years ago, the progress that has been achieved in this relatively short period of time is remarkable and emphasizes the importance of cooperative efforts between the Gluck Equine Research Center and the equine industry in addressing industry problems.

ADDITIONAL RESOURCES:

VIDEO ON ROTAVIRUS B- [HTTPS://YOUTU.BE/OIUZF04R4IG](https://youtu.be/OIUZF04R4IG)

VIDEO ON ROTAVIRUS B BIOSECURITY- [HTTPS://YOUTU.BE/H_GN_MHLIPO](https://youtu.be/H_GN_MHLIPO)

| *Source: January Equine Disease Quarterly.*

Emma Adam, DVM, PhD, MRCVS, DACVIM, DACVS, associate professor, research and industry liaison at the Gluck Equine Research Center

Feng Li, DVM, PhD, Professor and William Robert Mills Chair in Equine Infectious Disease, UK Gluck Equine Research Center

Dan Wang, PhD, assistant professor, Gluck Equine Research Center

MESSENGER RNA INSIGHTS COULD PROTECT THOROUGHBRED RACEHORSES FROM INJURIES



PHOTO COURTESY MARC PEARSON PHOTOGRAPHY.

Concerns over animal welfare and the risks of high-speed exercise have long plagued the racing industry. Now, a new study published in the *Journal of Equine Veterinary Science* reveals more insight into high-speed exercise, and how trainers can help with injury prevention and animal welfare.

The study, titled [“Effects of High-Speed Training on Messenger RNA Expression in Two-Year-Old Thoroughbred Racehorses”](#) published in the *Journal of Equine Veterinary Science* and funded by the Dubai Equine Hospital, aimed to determine if messenger RNA (mRNA) expression could be used to identify those young racehorses at risk for injury and whether there are predictable patterns of mRNA expression changes indicative of successful adaptation to exercise.

Messenger RNA, which acts as the “instruction manual” for creating specific proteins, has shown previous promise as a biomarker to monitor a horse’s capacity to adapt to training and its susceptibility to injuries. The study collected blood samples from 18 two-year-old Thoroughbreds throughout their first season of race training. The blood samples were collected weekly, prior to exercise or administration of medication. The researchers analyzed the expression of 34 mRNA markers in the blood samples using a technique called RT-qPCR.

“The study has revealed vital insights into racehorse health and performance,” said Allen Page, DVM, PhD, scientist and veterinarian with the University of Kentucky Gluck Equine Research Center. “This research

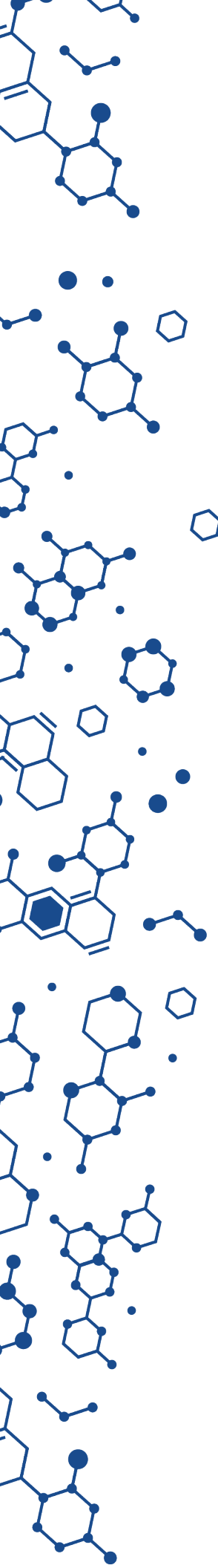


PHOTO COURTESY MARC PEARSON PHOTOGRAPHY.

signed to build upon our prior work that hinted at differences in mRNA expression between horses undergoing various training regimens where we saw profound differences we believed could signal an increased risk for injury.”

The initial research that laid the groundwork for this study, “[The Impact of Training Regimen on the Inflammatory Response to Exercise in 2-Year-Old Thoroughbreds.](#)” published in the *Journal of Equine Veterinary Science*, compared two groups of horses undergoing different training methods. While the primary focus was not on injuries, researchers noticed variations in mRNA expression that raised questions about injury risk. These differences suggested that one group of horses might be more prone to injuries than the other, although the study was not designed to directly investigate this aspect.

High-speed training, particularly breezing, is a crucial phase where the risk of injuries increases significantly.

“Injuries in racehorses can encompass a wide range of issues, from minor bone injuries that require brief rest to more severe problems like fractures or soft tissue injuries affecting tendons and ligaments,” Page

said. “These injuries can lead to varying degrees of lameness, affecting a horse’s racing career and overall well-being.”

The implications of the most recent study are significant for the racing industry. Firstly, the study offers the potential for a valuable biomarker that may predict impending injuries in racehorses. Detecting injuries at an early stage can lead to timely interventions, ultimately improving the well-being and racing careers of these horses, as well as the safety of the jockeys that ride them.

Additionally, trainers may be able to use this information to tailor their training programs for individual horses. By closely monitoring mRNA markers, trainers can gain insights into whether they are pushing a horse too hard or not challenging it enough. Ultimately, this personalized approach to training can optimize a horse’s performance and potentially reduce the risk of injuries.

The most striking discovery in this study was the discernible differences in mRNA expression between horses that eventually suffered injuries and those that completed the six-month training period without injury. These mRNA markers indicated that changes were occurring within the horses’ bodies in the weeks leading up to an injury.

“We found that injured horses,

in the weeks leading up to injury, had differences in some of their messenger RNA markers compared to the non-injured horses,” Page said. “So, hopefully, we have a biomarker there for an impending injury. Obviously, if you can identify injuries before they become significant, you can have a pretty profound effect on those horses because you can intervene.”

The study represents a significant step forward in the racing industry’s pursuit of better horse health and performance. While it does not delve into other factors contributing to injuries, it provides a promising avenue for early injury detection and tailored training programs. With the potential to revolutionize how horses are trained and cared for, this research offers hope for a safer and more successful future for Thoroughbred racehorses.

| *Jordan Strickler is an agriculture communication specialist in UK’s Martin-Gatton College of Agriculture, Food and Environment.*



UK VDL EQUINE ABORTION UPDATE

The University of Kentucky Veterinary Diagnostic Laboratory receives fetuses and placentas from cases of equine abortion throughout the year. The number of submissions vary between years, but there are typically 400-500 cases of fetal and perinatal loss submitted each foaling season. As of Jan. 5, 2024, a total of 219 equine fetuses have been submitted to the laboratory from the 2023 foal crop.

For each case, a diagnosis is made based on the combination of gross autopsy findings, microscopic examination and various PCR, virology and bacteriologic testing modalities. Diagnoses can be categorized into infectious and non-infectious causes of abortion. Infectious causes include ascending bacterial and fungal placentitis, fetal bacteremia, mucoid/nocardioform placentitis, equine herpesvirus (EHV) abortion, leptospiral abortion and *Neorickettsia risticii*, the cause of Potomac horse fever, associated abortion.

Causes of noninfectious abortion include congenital anomalies, umbilical cord torsion, cervical pole necrosis and fetal neoplasia. When no infectious agents or pathologic lesions are identified, then the abortion is designated as an abortion of undetermined etiology.

Diagnoses for the 2024 foal crop (figure 1) and prior four years (figure 2) are shown. For comparative reasons, Jan. 2 was used as the cutoff date for data analysis during each prior year.

| Source: Edited Jan. 22 VDL bulletin

Rebecca Ruby MSc, BVSc, Diplomate ACVP, ACVIM-LAIM, assistant professor of veterinary pathology, Department of Veterinary Science, UKVDL

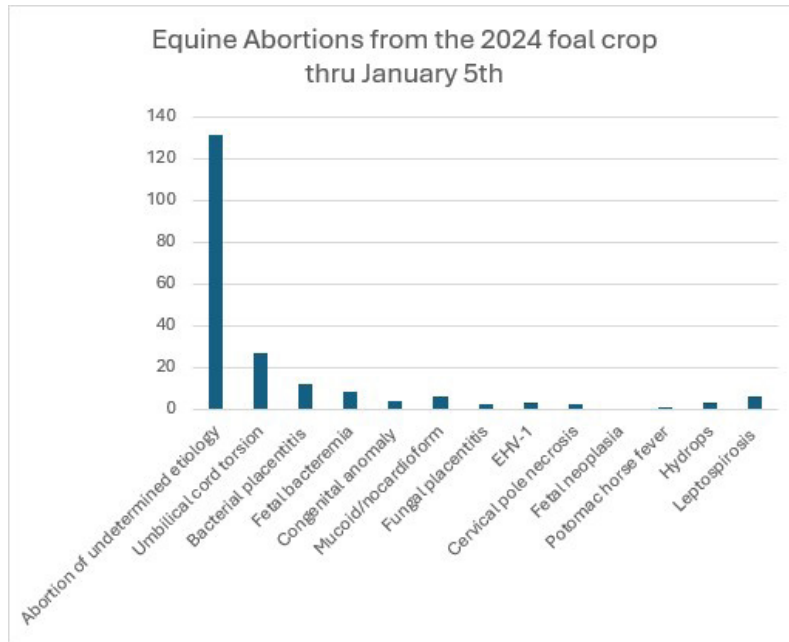


FIGURE 1. CAUSES OF ABORTION FROM THE 2024 FOAL CROP. A SMALL NUMBER OF DIAGNOSES ARE PENDING DUE TO RECENT SUBMISSION.

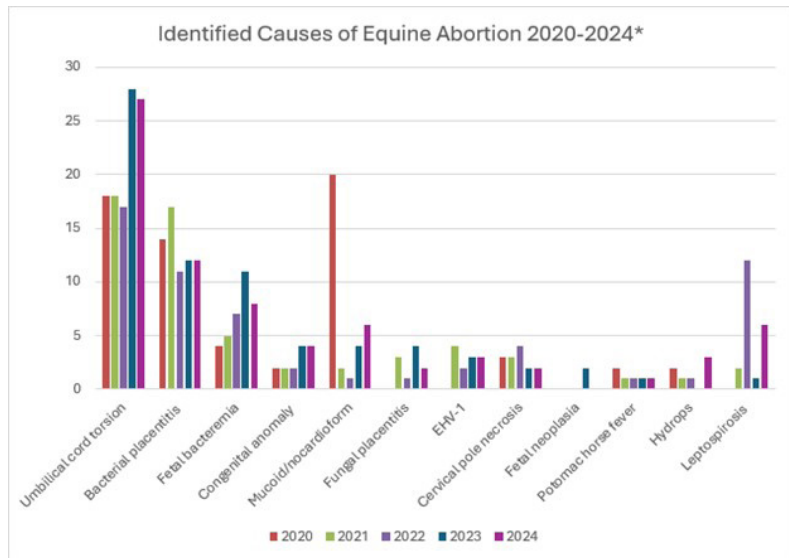


FIGURE 2. CAUSES OF ABORTION DURING THE 2020-2024 FOAL CROPS. *JAN. 2 WAS USED AS THE DIAGNOSIS CUTOFF DATE FOR 2020-2023, JAN. 5 FOR 2024.

UK RESEARCHERS WARN THAT RECENT WEATHER COULD BE PROBLEMATIC FOR MARES GRAZING TALL FESCUE PASTURES

According to researchers at the University of Kentucky Martin-Gatton College of Agriculture, Food and Environment, Kentucky's late summer drought, followed by mild/late fall weather and recent rains could put mares at risk on tall fescue pastures.

In a statement jointly issued by Megan Romano, PhD, assistant professor and veterinary toxicologist at the UK Veterinary Diagnostic Laboratory (VDL); Krista Lea, research analyst and coordinator of UK's Horse Pasture Evaluation Program; Emma Adam, DVM, PhD, MRCVS, DACVIM, DACVS, associate professor and research and industry liaison with UK's Department of Veterinary Science; and Ray Smith, PhD, extension professor and forage specialist within UK's Department of Plant and Soil Sciences, horse farm owners and managers were advised on the following.

Important observations:

- Recent rains after extended drought have enhanced endophyte-infected tall fescue production of the toxic compound, ergovaline.
- Owners should restrict exposure to ergovaline in late-term pregnant mares to avoid tall fescue toxicosis. Signs of tall fescue toxicosis include poor or absent milk production; poor udder development; prolonged gestation, greater than two weeks; thickened, retained placenta; "red bag" deliveries; and potentially fatal dystocia/foaling trauma.
- November and December are



PHOTO COURTESY DR. JIMMY HENNING.

typically low pasture growth months where low ergovaline levels are seen, however the UK VDL recently tested numerous tall fescue samples and detected high ergovaline levels. Often fescue is diluted with other grasses, but recent weather conditions have allowed fescue to grow while bluegrass and orchardgrass have slower growth or are dormant.

- This is an issue that can affect states beyond Kentucky. The "fescue belt" includes 50% or more of the acreage in the states of Alabama, Arkansas, Georgia, Illinois, Indiana, Kansas, Kentucky, Maryland, Mississippi, Missouri, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina, Tennessee, Virginia and West Virginia.

Protective measures:

- Removing mares 60-90 days from their due date from pastures containing more than 20% toxic tall fescue onto pastures containing mainly orchard grass, Kentucky bluegrass or novel endophyte fescue.
- Feeding appetizing, high-quality hay, such as alfalfa or alfalfa mixed hay, can dilute the intake of ergovaline eaten on pastures, reducing the risk in situations where moving mares to very low fescue pastures is not feasible.
- Discussing managing high-risk mares and using domperidone with a veterinarian.
- Once temperatures drop into the high teens, ergovaline usually drops for the remainder of the winter.

UK resources:

- Owners can test pasture samples for ergovaline at the UK VDL. Samples can be collected using the instructions found [here](#).
- Local county extension agents can assist with sampling and results interpretation. Find your county extension agent [here](#).
- Learn more about tall fescue, including mitigation strategies and new novel endophyte tall fescue varieties with no ergovaline, by visiting the Alliance for Grassland Renewal.
- Attend UK's Equines and Endophytes Workshop Jan. 31 in Lexington. Register today at <https://eew24.eventbrite.com>.

| *Source: Nov. 14 statement from the University of Kentucky Martin-Gatton College of Agriculture, Food and Environment.*



IN THE NEWS

University of Kentucky's **Maine Chance Farm** was recently highlighted with the Blood-Horse. See the video [here](#).

Two from the University of Kentucky Martin-Gatton College of Agriculture, Food and Environment recently appeared on an **equine podcast, Rood & Riddle Equine Hospital's Stall Side chat**. Krista Lea, MS, coordinator of the University of Kentucky's Horse Pasture Evaluation Program, and Emma Adam, DVM, PhD, MRCVS, DACVIM, DACVS, associate professor, research and industry liaison within the Department of Veterinary Science, talked about tall fescue. See the interview [here](#).

UK Scientists and Scholars Among Top 2% of World's Most-Cited Researchers. In a database compiled by Stanford University, 119 current UK scientists and scholars appear among the top 2% of the most-cited researchers across 22 disciplines. See the story [here](#).

UK's Camie Heleski participates in the "Creating a Good Life for Horses Workshops presented by MARS Equestrian™"

Source: Edited Jan. 25 story by Zack Ryle, US Equestrian

Two highly engaging workshops were the focus of the programming on Jan. 13 during the 2024 US Equestrian Annual Meeting.

The morning and afternoon sessions on "Creating A Good Life for Horses," graciously sponsored by MARS Equestrian™, were led by two of the leading equine academics in the United States Camie Heleski, PhD, Senior Lecturer at the University of Kentucky, and Jim Heird, PhD, executive professor at Texas A&M University.

Heleski shared the work she and her team completed for the Equine Ethics and Wellbeing Commission. The Commission is focused on helping the FEI be a leader in the areas of equine welfare, being a trusted voice, being transparent, being proactive and being accountable.

The Commission's report found six priority focus areas for the equine industry in order to maintain its social license to operate: Training and riding, tack and equipment; Recognizing physical and emotional stress with our horses; Accountability, enforcement, knowledge; The other 23 hours (What horses do while not training); People's competitive drive and treating the horse as a number; Horse's health problems that could mean the horse is not fit to compete – and the potential of masking said health problems

With these priority focus areas in mind, the Commission will be making recommendations to the FEI on the use of certain tack and equipment; a proposed rule that applies consistently to all disciplines, allowing elimination on the field of play on horse welfare grounds; and the creation of both an education group and the start of fundraising efforts to do more research in the area of equine welfare.

The story can be found in its entirety [here](#). YouTube coverage can be found [here](#).

FEEDING THE BROODMARE: FOUR EASY STEPS

The nutritional needs of broodmares change as they go through the stages of reproduction. This publication begins with nutritional strategies to enhance the likelihood a mare will become pregnant, then it discusses feeding management of the mare during pregnancy and lactation, and it ends with some nutritional considerations for the post-weaning period. Although nutrition is an important component of broodmare management, other factors also can affect reproductive efficiency and the ability of a mare to raise a foal. Clean, safe housing conditions as well as appropriate vaccination and deworming protocols are important components of all phases of broodmare management. In addition, effective heat detection, breeding and foaling procedures are required for a successful breeding program.

Step 1: Getting Pregnant

Research suggests body condition is one of the most important nutritional variables affecting reproductive efficiency in normal, healthy broodmares. The most common system for evaluating body condition uses a nine-point scale where a body condition score (BCS) of 1 is an extremely thin horse and a BCS of 9 is an extremely fat horse (Figure 1). Mares with BCS below 5 (moderate) have lower conception rates, require more cycles per conception, and cycle later in the year than mares with condition scores of 5 or higher. Many mares with BCS below 5 will get pregnant, but it may require more work and happen later in the year than desired.

Any mare that will be bred in the spring should be condition scored the previous fall to determine whether the mare is in optimal body condition or if she is too fat or too thin. Several examples of mares with different body condition scores are shown in Figures 2-5.

If body condition is not optimal, the diet should be adjusted to allow for weight gain or loss. If a mare is

Figure 1. Body Condition Scoring System for Horses

Score 1 (Poor)—Extreme emaciation; spinous processes, ribs, tailhead and hooks and pins are prominent; bone structure of withers, shoulder and neck are easily noticeable; no fatty tissue can be felt.

Score 2 (Very thin)—Emaciated; thin layer of fat over base of spinous processes; transverse processes of lumbar vertebrae feel rounded; spinous processes, ribs, tailhead and hooks and pins are prominent; withers, shoulders and neck structures are faintly discernible.

Score 3 (Thin)—Fat about halfway up spinous processes; transverse processes cannot be felt; thin fat layer over ribs; spinous processes and ribs are easily discernible; tailhead prominent, but individual vertebrae cannot be visually identified; hook bones appear rounded but not easily discernible; pin bones not distinguishable; withers, shoulders and neck are accentuated.

Score 4 (Moderately thin)—Ridge along back; faint outline of ribs discernible; tailhead prominence depends on conformation, but fat can be felt around it; hook bones not discernible; withers, shoulders and neck are not obviously thin.

Score 5 (Moderate)—Back is level; ribs cannot be visually distinguished but can be easily felt; fat around tailhead beginning to feel spongy; withers appear rounded over spinous processes; shoulders and neck blend smoothly into body.

Score 6 (Moderate to fleshy)—May have slight crease down back; fat over ribs feels soft and spongy; fat around tailhead feels soft; fat beginning to be deposited along sides of the withers, behind the shoulders and along the sides of the neck.

Score 7 (Fleshy)—May have crease down back; individual ribs can be felt, with noticeable filling between ribs with fat; fat around tailhead is soft; fat deposited along withers, behind shoulders and along neck.

Score 8 (Fat)—Crease down back; difficult to feel ribs; fat around tailhead very soft; area along withers filled with fat; area behind shoulder filled in flush; noticeable thickening of neck; fat deposited along inner buttocks.

Score 9 (Extremely fat)—Obvious crease down back; patchy fat appearing over ribs; bulging fat around tailhead, along withers, behind shoulders and along neck; fat along inner buttocks may rub together; flank filled in flush.

Adapted from Henneke et al., 1983



FIGURE 2. HORSE HAS A BCS OF 4: THE RIBS ARE FAINTLY VISIBLE, AND THE BACK HAS A SLIGHT RIDGE ALONG IT. THE NECK IS NOT NOTICEABLY THIN, BUT THE SHOULDER STRUCTURE IS BECOMING VISIBLE.



FIGURE 3. HORSE HAS A BCS OF 5: THE RIBS ARE NOT VISIBLE, NECK IS NOT THIN OR FAT, WITHERS AND SPINE AND HIP STRUCTURES ARE NOT VISIBLE.



FIGURE 4. HORSE HAS A BCS OF 6: RIBS ARE NOT VISIBLE, NECK IS SLIGHTLY THICK, SOME FAT FILLING IN BEHIND SHOULDER, IN FLANK, AND OVER WITHERS.



FIGURE 5. HORSE HAS A BCS ABOVE 7: THE NECK IS THICK, FAT IS FILLING IN BEHIND SHOULDER AND IN FLANK, AND THE RIBS ARE BECOMING HARD TO PALPATE. TO DETERMINE WHETHER THIS HORSE IS A BCS 8 OR 9, PALPATION OF THE TAIL HEAD, RIBS, AND OTHER AREAS WOULD BE NECESSARY.

too thin, then forage quality and/or quantity should be increased first. When a change in forage availability is not enough to produce the desired body condition, then concentrate intake should be increased. The term “concentrate” refers to a feed that provides a concentrated source of calories. The simplest concentrate is a plain cereal grain such as oats or corn. Plain cereal grains are good sources of calories, but they are deficient in calcium and other nutrients. In most cases, it is better to purchase a commercially manufactured fortified concentrate formulated specifically for broodmares. Commercially manufactured concentrates come in two main forms, a sweet feed (also called a textured feed or an open mix) and pellets. Either physical form is acceptable if the nutrient composition of the feed is designed for broodmares.

The amount of extra concentrate needed to improve BCS for any mare will depend on the size of the mare, the initial and target BCS and the diet she is getting. For some mares, simply increasing the quality and quantity of forage (pasture or hay) available will be sufficient to adjust body condition. For other mares, it will be necessary to feed additional concentrate. For example, if a Thoroughbred-type mare is maintaining a BCS of 4 with unlimited access to good hay/pasture and 3 pounds of concentrate, it may be necessary to feed as much as 6 to 8 pounds of concentrate per day to increase her BCS to 6 in about two months. Any changes in feeding programs should be implemented gradually, so the amount of concentrate should be increased slowly. Once she reaches her target BCS, the amount of concentrate usually can be reduced.

It is difficult to get some mares to gain weight during the winter unless they receive large amounts of concentrate. Large concentrate intakes have been associated with an increased risk of colic. Therefore, if a mare is somewhat thin in October, it is important to

start adjusting the diet right away to promote weight gain before mid-December and avoid the need for high concentrate intakes later in the winter.

There is no reproductive benefit to mares who are excessively fat. If a mare is condition scored in October and determined to be too fat, then the diet can be adjusted to reduce calorie intake. Non-pregnant mares with Quarter Horse, Arabian or Morgan breeding will often be able to maintain adequate body condition during the fall and winter on good quality forage and a minimal amount of concentrate. If mares are too fat, the first dietary change should be a reduction in concentrate intake.

Although there does not appear to be any reproductive advantage to a condition score above 7, it may be beneficial for mares to have a body condition score slightly above 5 before the coldest part of winter. If they have a condition score above 5 at the onset of winter, they will have a buffer of expendable body fat that can be used during severe cold. The goal is to make certain that mares do not have a BCS below 5 at the beginning of the breeding season.

Step 2: Meeting the Needs of Gestation

A foal has already attained about 60 percent of its mature height at birth. That means the dam has to provide adequate nutrition for the foal’s skeleton during gestation. She can provide this nutrition by eating and processing additional nutrients in her diet, or by robbing nutrients from her body to meet the needs of the developing fetus. Optimal feeding programs will minimize the need for mares to use their own body stores.

Table 1 shows the effect of gestation on the nutrient requirements of 1,250-pound mares. The National Research Council publication “Nutrient Requirements of Horses” suggests that the nutrient requirements of pregnant mares start to increase above maintenance in the fifth month of gestation. This is a new recommendation; previously it was suggested that nutrient

needs did not increase until the eighth month of gestation.

Many mares in Kentucky will be grazing good quality fall pasture during the middle months of gestation. Good quality pasture may provide enough energy to maintain a BCS above 5 without much concentrate supplementation. However, Kentucky pasture alone may not meet the mineral requirements of gestating mares. If pregnant mares are not receiving any concentrate, a mineral supplement should be given at least once a day. A convenient supplement source is a balancer pellet (Figure 6), also called a supplement pellet, which is sold by many feed companies. Feeding 1-2 pounds of a typical balancer pellet during mid-gestation should ensure adequate daily mineral intakes of mares that are grazing pasture. A salt block should be available to provide sodium chloride for horses. Although trace mineral salt blocks and other mineral blocks are available for horses, most horses will use them inconsistently. Therefore, it is difficult to count on these blocks to meet the mineral needs of every mare.

Pregnant mares should be maintained at a BCS of at least 5. A slightly higher BCS will ensure that the mares have a buffer of body stores at foaling and in early lactation. When forage quality or quantity is not enough to maintain body condition, concentrate should be added to the diet. A commercially manufactured concentrate that is fortified to meet the needs of broodmares is an excellent choice when concentrate is needed in the diet. As mares approach the end of gestation, appetite may decline, so concentrate intake may have to be increased. A typical diet for a Thoroughbred-type mare in the last month of gestation might be 20-25 pounds of good quality hay and 6-8 pounds of a concentrate. Some mares may require more or less concentrate to maintain body condition. If mares live outside during the winter, additional hay or concentrate often will be necessary.

Table 1. Nutrient Requirements of Gestating Mares (1,250 pounds).

Nutrient	Months							
	0-4	5	6	7	8	9	10	11
Digestible energy (Mcal/d)	18.9	19.4	19.8	20.3	21	21.9	23	24.3
Crude protein (g/d)	716	778	800	828	863	905	955	1014
Calcium (g/d)	23	23	23	32	32	41	41	41
Phosphorus (g/d)	16	16	16	23	23	30	30	30
Copper (mg/d)	114	114	114	114	114	142	142	142
Selenium (mg/d)	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1

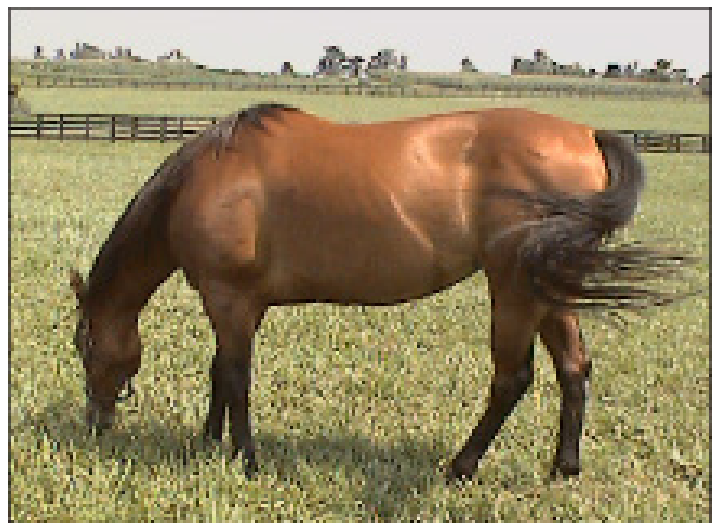
Source: National Research Council (2007).

Figure 6. What is a balancer pellet?

A balancer pellet is a concentrated source of minerals and vitamins. It is fed in small amounts each day (1-2 pounds). It is used when the diet provides adequate calories, but not trace nutrients. A balancer pellet is not needed if the diet already contains at least 3 pounds of a fortified commercial concentrate formulated for broodmares. The amount of protein in a balancer pellet can vary widely. When horses are receiving a high protein forage it is not necessary to use a high protein balancer pellet.

Typical composition of a balancer pellet:

Crude Protein	14-32%
Calcium	2-4.5%
Phosphorus	1.5-2.5%
Copper	150-200 mg/kg
Zinc	400-600 mg/kg
Selenium	1.5-2.5 ppm
Vitamin E	250-500 IU/lbs



GOOD-QUALITY PASTURE CAN PROVIDE CALORIES AND PROTEIN, BUT A DAILY SUPPLEMENT, SUCH AS A BALANCER PELLETT, IS USUALLY NECESSARY TO ENSURE THAT THE MINERAL NEEDS OF PREGNANT MARES ARE BEING MET.

Step 3: Meeting the Needs for Lactation and Rebreeding

A 1,200- to 1,300-pound mare will produce about 40 pounds of milk each day in early lactation. Milk contains energy, protein, calcium, phosphorus and an array of other nutrients.

Mares can produce normal milk even when their diet is deficient in some nutrients because they will mobilize nutrients from their own body. Feeding programs for lactating mares should ensure the diet provides all of the nutrients needed for milk production, so mares don't have to rob their own body stores. A 1,250-pound mare in early lactation needs about 36 megacalories of digestible energy, 1,740 grams of crude protein, 67 grams of calcium, 43 grams of phosphorus, 142 milligrams of copper and 1.4 milligrams of selenium in the diet each day. When these nutrient needs are compared to the requirements in Table 1, it is easy to see that lactation is more nutritionally demanding than gestation.

Lactating mares have much greater appetites than late gestating mares so the first dietary change should be an increase in feed intake. Lactating mares may consume more than 30 pounds of hay per day. The use of good-quality hay reduces the amount of concentrate needed in the diet. Good-quality alfalfa or alfalfa-grass hays are suitable for lactating mares. Good-quality pasture is also an excellent forage source, and hay may not be necessary when pasture is abundant.

Broodmares should be fed a concentrate that is formulated for the needs of mares and foals. Depending on the size of the mare, concentrate intakes usually will range from 5 to 12 pounds per day in early lactation and then decrease as the mare approaches weaning. To maximize rebreeding efficiency, mares should foal with a BCS of at least 5 and then maintain that condition score. Loss of body condition during lactation indicates that nutrient intake is not sufficient and the diet should be changed. If a mare has been rebred, she will be entering mid-gestation about the time her current foal is weaned.

Our research suggests that all mares mobilize some body stores, especially bone mineral during lactation, so the post-weaning period is an opportunity to replenish those stores before the demands of fetal development are great. If a mare is in adequate body condition at weaning, she can receive the balancer-pellet program described for gestating mares above. If she is in thin body condition at weaning, she will need to receive enough concentrate to increase her BCS to at least 5. Horse owners should identify mares that typically lose condition during gestation and consider a dietary plan that will give those mares a larger buffer of nutrient stores at the onset of lactation. For example, if a mare foaled at a BCS of 5 and ended lactation at a BCS of 4, the horse owner might consider feeding the mare enough during gestation so she will foal at a BCS of 6 the next year.

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National Research Council. 1989. *Nutrient Requirements of Horses*. National Academy Press, Washington, D.C.
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| *Source: edited publication by Laurie Lawrence, PhD, professor, and Fernanda Camargo, DVM, PhD, associate professor, both within the University of Kentucky Martin-Gatton College of Agriculture, Food and Environment's Department of Animal and Food Sciences. To see the publication online: <https://afs.ca.uky.edu/content/feeding-broodmare-four-easy-steps>*

Table 2. Average Composition of Forages Used for Horses (100% dry basis).

Forage	DE (Mcal/lb)	Crude Protein (%)	Calcium (%)	Phosphorus (%)	Copper (mg/kg)	Zinc (mg/kg)
Mixed Pasture (Central Ky., spring)	0.9-1.1	15-20	0.4-0.6	0.2-0.4	6-8	25-40
Alfalfa-midbloom	0.9-1.1	16-18	1.0-1.5	0.2-0.4	6-8	25-40
Alfalfa-Timothy mix	0.8-1.0	12-16	0.7-1.2	0.2-0.4	6-8	25-40
Timothy-head	0.7-0.9	7-11	0.3-0.5	0.2-0.4	6-8	25-40

Source: NRC (1989) and L. Lawrence (unpublished data).

Figure 7. How do I Know if I am Meeting the Requirements?

It is relatively simple to calculate the amount of any nutrient you are feeding if you know the amount of feed that is consumed and the nutrient composition of the feed.

The first step is to weigh each feed the horse is getting (hay and concentrate). If horse is also getting pasture, you will have to guess at intake. A rule of thumb is two pounds of pasture dry matter for each 100 pounds of body weight if the horse is turned out in good quality pasture 24 hours per day.

The second step is to determine the nutrient content of each feed. The feed bag should have some information about the nutrient content of the concentrate. To get information about hay, you can either look in a feed table or you can get your hay analyzed. Analysis is more accurate but also more expensive.

Next you calculate nutrient intakes by multiplying amount by concentration. Finally, compare the intakes to the requirement.

Most requirements are expressed in grams, so if your feed amounts are in pounds you will have to convert them to kilograms.
1 pound = 0.454 kilograms = 454 grams

Example: A mare is eating 22 pounds of hay and 4.4 pounds of concentrate. So, the mare is eating 10 kilograms of hay and 2 kilograms of concentrate.

The hay contains 10% crude protein (or 100 grams of CP per 1000 grams of hay; or 100 grams of CP per kilogram of hay). The concentrate contains 12% crude protein (or 120 grams per 1000 grams of concentrate; or 120 grams per kilogram).

Her crude protein intake is:
10 kg hay x 100 g CP = 1000 grams CP in hay
 $\frac{1000 \text{ g}}{1 \text{ kg}}$
2 kg concentrate x 120 g CP = 240 g CP in concentrate
 $\frac{240 \text{ g}}{1 \text{ kg}}$
Total grams of CP consumed = 1240 g CP per day

If you compare this value to the CP requirements for broodmares, you will see it meets the needs for 1,250-pound mares during gestation but not lactation. You would use this same process to calculate the intakes of all of the required nutrients.



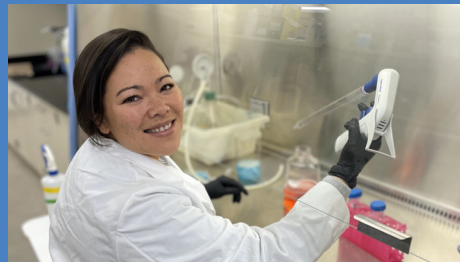
GOOD QUALITY PASTURE IS AN EXCELLENT SOURCE OF NUTRIENTS FOR LACTATING MARES. MOST MARES ALSO WILL NEED SUPPLEMENTAL CONCENTRATE. A CONCENTRATE FORMULATED FOR BROODMARES SHOULD BE USED. WHEN PASTURE AVAILABILITY DECLINES, MARES SHOULD BE OFFERED HAY.

ACCOLADES

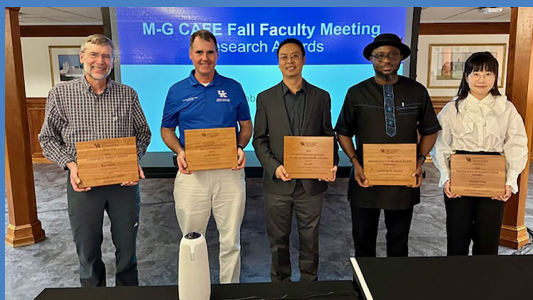
Lutz Goehring was awarded the World Equine Veterinary Association – Boehringer-Ingelheim Clinical Research Award during the WEVA conference Nov. 18-11, 2023. Pictured: Dr. Vince Gerber, University of Berne, Switzerland (left), Dr. Ulrike Voigt (Boehringer-Ingelheim, global), Dr. Sarah Reuss (Boehringer-Ingelheim, USA), Dr. Maria Paz Zúñiga Barrera (WEVA president).



Lynn Leedhanachoke recently won the UK Department of Veterinary Science Three-Minute Thesis (3MT) competition, hosted at the UK Gluck Equine Research Center. Leedhanachoke's thesis focuses on the effect of gastrointestinal infections in horses using organoids, miniature organs cultivated in a lab setting. Read more [here](#).



Congratulations to **Yosra Helmy**, PhD, assistant professor at the Gluck Equine Research Center. She is one of two recipients of the university's Center for Clinical and Translational Science (CCTS) career development award. The CCTS supports junior faculty members working in clinical/translational research and provides financial support and mentorship for talented scientists. Read more about the program [here](#).



Ray Smith (photo left), pictured on the left) was recognized with the UK's Martin-Gatton College of Agriculture, Food and Environment's Research/Extension Impact Award in late 2023 for his work with the college's highly successful pasture evaluation and extension programming during the previous five years.