Journal of
SWINE HEALTH & PRODUCTION
July and August 2023 • Volume 31, Number 4

The Journal of the American Association of Swine Veterinarians

The *Journal of Swine Health and Production* is published by the American Association of Swine Veterinarians.

The *Journal of Swine Health and Production* is a refereed publication and is a benefit of membership in the American Association of Swine Veterinarians. For inquiries regarding membership or subscriptions, please contact:

AASV
830 26th Street, Perry, IA 50220-2328
Tel: 515-465-5255
Email: aasv@aasv.org

Editorial questions, comments, and inquiries should be addressed to Rhea Schirm, Publications Manager: Email: jshap@aasv.org.

DISCLAIMER

Scientific manuscripts published in the *Journal of Swine Health and Production* are peer reviewed. However, information on medications, feed, and management techniques may be specific to the research or commercial situation presented in the manuscript. It is the responsibility of the reader to use information responsibly and in accordance with the rules and regulations governing research or the practice of veterinary medicine in their country or region.

Journal of Swine Health and Production is indexed in ISI®Focus On: Veterinary Science & Medicine,® and in CAB Abstracts, Euroscience VETLINE on CD-ROM

JOURNAL OF SWINE HEALTH AND PRODUCTION

(ISSN 1537-209X) Volume 31, Number 4; July and August

AASV STAFF

AASV OFFICERS

JSHAP STAFF

EDITORIAL BOARD

TABLE OF CONTENTS

Cover photo is courtesy of Tina Smith.

Download this issue at **www.aasv.org/shap/issues/v31n4/v31n4jshap.pdf**

JSHAP SPOTLIGHT

Dr Billy Flowers

North Carolina State University

Dr Billy Flowers earned a BS ('82) from Virginia Tech and an MS ('84) and PhD ('87) from the University of Missouri. Dr Flowers currently teaches reproductive physiology and swine management to undergraduate, graduate, and veterinary students at North Carolina State University. His applied research program focuses on how the early neonatal environment affects adult lifetime productivity. Dr Flowers chooses to serve as a JSHAP reviewer because "Publication of peer-reviewed data is a responsibility of everyone that works in academia. It is not possible to have peer-reviewed publications without people that agree to review submitted articles. I like JSHAP because it provides several avenues for authors to publish their work with peer review other than as a formal research article. The 'Practice Tips' are a good example."

Be Certain.

APPROVED TO KILL ASFv

FEEL PROTECTED AND CONFIDENT

We know the devastating impact that African Swine Fever can have. Intervention® Disinfectants, powered by Accelerated Hydrogen Peroxide®, is approved as an effective disinfectant to fight against ASFv. Its gentle formulation is highly effective against deadly pathogens while remaining safe for you and your animals. That's something to be certain about.

InterventionDisinfectants.com

VIROX TECHNOLOGIES INC. | Creators of ACCELERATED HYDROGEN PEROXIDE® Patented | INTERvention®

Intervention® is a member of the Virox family of brands.

*Refer to product label and reference sheet for full list of claims, contact times and use-directions.
You must read and follow the instructions on the label for our product and use the product for the particular applications specifi ed on the product label.
AHP® and Design and Accelerated Hydrogen Peroxide® and Design are trademarks of Diversey, Inc.

A peak behind the curtain

What is going on behind the scenes? If you have not familiarized yourself recently with the committees, activities, and membership representatives for the organization, I strongly suggest you invest a little time exploring the AASV website. We are fortunate as an organization to have 16 standing committees with dozens of volunteer members willing to lead and debate difficult topics such as influenza, early career development, pharmaceutical issues, and porcine reproductive and respiratory syndrome. We are also fortunate to have members willing to represent the organization in allied groups such as the American Veterinary Medical Association, National Pork Producers Council, National Pork Board, and others.

We owe a great deal of gratitude to these volunteer members who take up the cause of speaking up for our industry and our organization. I challenge members to identify a place for your voice and your talent within the AASV. Search the AASV tab on the website and email your District Director. This past week, the AASV Board of Directors met to debate important topics and review initiatives brought forward by the committee chairs, who were invited to attend the first day of a 2-day meeting. Each chair presented their committee work and opened discussion for actions needed or funding requests. Each committee met to discuss and debate relevant issues during the Annual Meeting and brought forward activities and funding priorities for the board to consider.

It was interesting to me that every committee brought forward proposed actions this year. I am pleased to see the drive to improve the organization and its membership. I am also pleased to hear debate on funding needs where the greater industry may need a push or need coordination and leadership for scientific decision making. Something very exciting in the budget stands out, the AASV staff are fully engaged in the pursuit of taking action. The board learned of both external grants for project funding and internal action items for growing the organization. My hope is that you have already met Dr Abbey Canon and Sherrie Webb and shared an email with the new JSHAP Publications Manager and AASV Foundation Manager Rhea Schirm. I am certain you already know the tremendous support our organization receives from Associate Director Dr Sue Schulteis and leadership from Executive Director Dr Harry Snelson. My ask is for you to read about the communications, organizational structure, grant proposals, and report of work all put together by the excellent AASV staff.

The AASV Board of Directors are active in discussions and blessed to enjoy the progress reports of motivated committee chairs and staff. Read a summary of these discussions and actions in the recent District Director report sent to members in May. Now we each must do our part to take up the challenge. Look for a committee or an organization with volunteer opportunities. Call or email the chair of a committee focused on an area of interest to you. Reach out with ideas for the Annual Program Planning Committee to consider when they meet in June. And get yourself to the World Pork Expo that happens yearly in June where we expect to meet face-to-face again and talk about important AASV issues in the members-only session.

" I challenge members to identify a place for your voice and your talent within the AASV."

Finally, as you review the AASV website for personal motivation, take some time to search the AASV resources. As members we have access to a war chest of information and support. Images, podcasts, videos, and previous meeting proceedings are all waiting for you. By now you should have already completed the 2023 AASV Salary Survey. We need this data to help build financial information and provide salary benchmarking for the membership. Rumor has it the small animal folks are making rapid salary changes given the demand for companion animal services for all the new "COVID pets"! Our organization needs to gather current compensation data to make sure the swine industry is competitive in attracting all the best new veterinary talent available. There is a lot going on behind the scenes. We are blessed with excellent motived members and staff. We have a large group of volunteer members doing very good work. Familiarize yourself with what is going on. Go team!

William L Hollis, DVM
AASV President

Shaping the future **of piglet care**

Prepare, protect, and support resilience in your piglets.
As your partner, we provide local swine expertise and complete, tailor-made solutions to help you achieve your goals. Together, we can create a new future for piglet care.

If not us, who? If not now, when?

WE MAKE IT POSSIBLE

dsm.com/PigletCare

Follow us on:

ANIMAL NUTRITION AND HEALTH

- ESSENTIAL PRODUCTS
- PERFORMANCE SOLUTIONS + BIOMIN®
- PRECISION SERVICES

DSM
BRIGHT SCIENCE. BRIGHTER LIVING.

Enjoy your retirement, Plum

The United States Department of Agriculture (USDA) held a ribbon cutting ceremony on May 24, 2023 to announce the official "opening" of the National Bio and Agro-Defense Facility (NBAF). The NBAF, located in Manhattan, Kansas, will ultimately replace the Plum Island Animal Disease Diagnostic Center (PIADDC) located in New York. The PIADDC has served as the nation's research and regulatory diagnostic facility for transboundary animal diseases (often referred to as foreign animal diseases) since 1954 under USDA. The facility at Plum Island served the country's livestock industries well during those nearly 70 years but has aged well beyond its prime.

I was fortunate to have had the opportunity to participate in a swine-focused Foreign Animal Disease Diagnostician class in 2000 on Plum Island. I have been back for meetings and tours several times over the years. Even in 2000, the facility was showing its age. It needed a serious influx of cash for maintenance and upgrades for many years. Paint was peeling and roofs were leaking. Much of the research space was dark and dungeon-like. Its biosafety level (BSL) -3 designation allowed researchers to work on most diseases of importance to livestock. The country, however, had no capability to research BSL-4 agents in large animals. In addition, the high-level containment facilities at Plum Island only allowed for research on small numbers of large-animal species such as cows and pigs.

In response to the events of 9-11, the US government officially recognized agriculture as a critical infrastructure. The newly formed Department of Homeland Security (DHS) was tasked with protecting that infrastructure and took over the management of Plum Island in 2002. The USDA was ordered to provide funding to help support DHS's takeover of the facility. Over the strong objections of the US swine industry, USDA decided to eliminate the African swine fever (ASF) research program at Plum Island to help provide the necessary funding. The government's rationale at the time was that ASF had never been in the United States and had long been confined to Sardinia and Sub-Saharan Africa. Thus, the ASF research program was discontinued. This decision effectively ended most of the vaccine and diagnostic research globally prior to the current outbreak.

To their credit, DHS was able to bring much needed dollars to maintain, repair, and upgrade the facilities at Plum Island and increase the level of security. It was soon realized, however, that a major overhaul was needed if the PIADDC was to continue to effectively and safely address the research, diagnostic, and regulatory issues associated with pathogens of concern to US animal agriculture. Ultimately it was determined that a new facility should be constructed and would be located on the mainland.

After considering almost 30 potential sites, DHS selected Manhattan, Kansas in 2008. Following challenges to the site selected and additional site-specific risk assessments, construction began in 2010 with clearing and grading of the proposed site. Actual construction of the laboratory began in 2015. In 2014, the federal government budgeted $440 million for construction of the facility. Over the years, the budget ballooned to a final cost of $1.25 billion for the 574,000 square-foot facility. Design and construction were focused on ensuring the security of the laboratory from potential intruders and to keep pathogens from escaping. At the time of the ribbon cutting, there were approximately 280 of the projected 400 employees working at the facility. One of the issues AASV and others in animal agriculture have raised is the need to ensure that USDA and Congress are committed to adequately funding the ongoing maintenance and security necessary to safely operate the lab. Although I have not seen any official estimates of what this cost may be, I have heard figures as high as $100 million annually. That would be a significant hit to USDA's annual budget and must be addressed with additional funding rather than pirating existing programs.

I was fortunate to have the opportunity to tour the NBAF just prior to the ribbon cutting. It is a beautifully designed facility and obviously state of the art. It should function well to service the needs of animal agriculture for decades to come. I am interested to see what research will be undertaken to justify the construction and maintenance of the facility. We in the livestock industry need to work hard to ensure that animal agriculture's needs remain paramount.

I will admit, it is a little sad to see the closure of Plum Island. It was such an iconic facility in support of animal agriculture with such a storied history. It is still unclear what will happen to that property. The latest I have seen is a proposal to preserve it as a national monument or perhaps it may be sold. I think it is important to recognize and thank all those researchers and employees who endured everything that working on Plum Island entailed. Working on Plum Island was fraught with challenges. There was a general lack of local support coupled with suspicion about activities on the island. Getting to work every day meant often braving a stomach-churning boat ride, and the occasional threat that one may have to leave work early or plan to spend the night if the weather turned severe. Their dedication to their mission, despite the numerous challenges, resulted in an amazing amount of high-quality, globally recognized research targeting potentially devastating livestock diseases. The US and global animal agriculture industries owe those folks a debt of gratitude and they set a high standard for our expectations at NBAF. And, it is nice to see that the alien has a nice new home.

Harry Snelson, DVM
Executive Director

Are you and your clients prepared to respond to a Foreign Animal Disease?

Get ready with the **CERTIFIED SWINE SAMPLE COLLECTOR** training program

1. Contact the State Animal Health Official (SAHO) in the state(s) in which you plan to train or use Certified Swine Sample Collectors (CSSCs) to confirm participation eligibility prior to participating in the program.
2. Review the CSSC Program Standards.
3. Identify individuals who could be trained to collect and submit samples on your behalf.
4. Access CSSC training materials at securepork.org/cssc.
5. Conduct classroom and hands-on training.
6. Submit a list of trained individuals to SAHO(s) in state(s) trainees will be collecting samples.

CSSC

For more information on the training program ←

If you are ready to start training, contact the state animal health officials in the state in which you wish to train individuals ←

For additional information or if your state isn't listed, please contact Pam Zaabel at pzaabel@pork.org.

The JSHAP publication manager and advertising coordinator roles

As I approach my one-year anniversary of taking the publication manager position, I remember feeling so overwhelmed by all the information Karen Richardson housed in her brain. She was an amazing teacher and excellent resource, and a genuine bright light. Finally getting to meet her in person at the AASV Annual Meeting was a joy and getting to know her was even more fun – I know a lot of you can relate.

My role with JSHAP can be described as the herder of cats and content guru with a hand in all parts of the journal before it is combined into an issue. As you know, cats have their own agendas, ideas, and minds. My primary role is to make sure we all come to the same goal of moving all the pieces forward and publishing each JSHAP issue on time.

The peer-review process can be seen as a journey for each manuscript. The journey begins when the manuscript comes via a simple email submission to the JSHAP email. After I receive the manuscript, I provide the information to our Executive Editor, Dr Terri O'Sullivan, with whom I meet with weekly to review new submissions, current submissions, and peer reviews. The next step in the manuscript's journey is the evaluation of the manuscript for review. If the manuscript is accepted for review, I work with the authors to complete the signoff for the prereview copyright. I then contact a lead reviewer to help us navigate the review process and identify who would be a good fit to review the manuscript.

Once the reviewers are identified, I reach out to them and confirm their willingness to assess the manuscript. It can be challenging and time consuming to find reviewers due to their busy schedules and other obligations. Reviewers are then given 3 weeks to review the manuscript. When the reviews are returned, a report is compiled and sent to the lead reviewer. The lead reviewer makes a recommendation on publication of the manuscript and I meet with Dr O'Sullivan again to decide the next step. The manuscript can either be accepted and proceed through the editorial and publication process; sent back to the authors to revise according to the peer-review comments; or the manuscript is rejected.

"The peer-review process can really be seen as a journey for each manuscript."

If the manuscript is accepted, I contact the author with a letter explaining when their manuscript will be published and include the final copyright form to complete and return. The manuscript continues its journey with Associate Editor Sherrie Webb. I also work with our translators who create the French and Spanish translations for the Summary.

For each JSHAP issue, I contact all individuals that are responsible for other sections published in the journal including the editorial messages, news features, and spotlights. My main focus is sending lots of reminders and gentle nudges to move their part forward through the process. I also work directly with the companies that advertise in JSHAP. I reach out to each advertiser to confirm their ad placement in the journal issue and remind them of the submission deadline for receiving their advertisement for inclusion in the issue.

It has been a very wonderful journey of getting to know the process. As I approach the end of my first year as the JSHAP publication manager, I am grateful to be in contact with so many great people and have the opportunity to learn so much.

Rhea Schirm
Publication Manager and Advertising Coodinator

Influence of biological sample pre-analytical manipulation for fat-soluble vitamin analysis

Sarah Elefson, MS; Laura L. Greiner, PhD

Summary

Objective: Determine how sample handling affects nutrient analysis of fat-soluble vitamins and minerals.

Materials and methods: In experiment 1, blood was collected in either plasma or serum blood tubes and exposed to 4 hours of light or wrapped in aluminum foil to protect from light. In experiment 2, blood was collected at hours 0, 1, 2, 3, 4, 6, and 12 after the consumption of feed. In experiment 3, vitamins and minerals were assessed in varying degrees of hemolyzed blood samples. Experiment 4 evaluated liver samples exposed to various temperatures for up to 12 hours. In experiment 5, serum and liver samples were processed the day of, 1 day after, or 2 days after collection and subsequent placement into coolers with icepacks.

Results: There was a significant difference ($P < .05$) for the interaction of tube type and light exposure for vitamin D (25-hydroxyvitamin D_3) and a tendency ($P < .10$) for a tube type and light exposure interaction for vitamin A (retinol). Experiment 2 found serum vitamin concentrations changed post feed consumption both linearly and quadratically. Alpha-tocopherol peaked at 4 hours post meal consumption, whereas retinol peaked at 6 hours. In experiment 3, the degree of hemolysis affected ($P < .05$) nutrient concentration. Experiment 4 and 5 showed no differences ($P > .05$) in degradation of retinol and alpha-tocopherol.

Implication: As many pre-analytical factors can affect laboratory results, care must be taken when collecting, handling, and storing samples for diagnostic analysis of vitamins and minerals.

Keywords: swine, blood tube, pharmacokinetic, hemolysis, degradation

Received: December 9, 2022
Accepted: March 16, 2023

Resumen - Influencia de la manipulación preanalítica de muestras biológicas para el análisis de vitaminas liposolubles

Objetivo: Determinar cómo el manejo de la muestra afecta el análisis de nutrientes de vitaminas y minerales liposolubles.

Materiales y métodos: En el experimento 1, la sangre se colectó en tubos de sangre de plasma o suero y se expuso a 4 horas de luz o se envolvió en papel de aluminio para protegerla de la luz. En el experimento 2, se recolectó sangre en las horas 0, 1, 2, 3, 4, 6, y 12 después del consumo de alimento. En el experimento 3, se evaluaron las vitaminas y los minerales muestras de sangre en diversos grados de hemólisis. El experimento 4 evaluó muestras de hígado expuestas a varias temperaturas durante un máximo de 12 horas. En el experimento 5, las muestras de suero e hígado se procesaron el día, 1 día después, o 2 días después de la recolección y posterior colocación en hieleras con congelantes.

Resultados: Hubo una diferencia significativa ($P < .05$) para la interacción del tipo de tubo y la exposición a la luz para la vitamina D (25-hidroxivitamina D_3), y una tendencia ($P < .10$) para el tipo de tubo y la interacción de la exposición a la luz para la vitamina A (retinol). El experimento 2 encontró que las concentraciones de vitaminas en suero cambiaron después del consumo de alimento tanto lineal como cuadráticamente. El alfa-tocoferol alcanzó su punto máximo 4 horas después del consumo de alimento, mientras que el retinol alcanzó su punto máximo 6 horas después. En el experimento 3, el grado de hemólisis afectó ($P < .05$) la concentración de nutrientes. Los experimentos 4 y 5 no mostraron diferencias ($P > .05$) en la degradación de retinol y alfa-tocoferol.

Implicación: Dado que muchos factores preanalíticos pueden afectar los resultados de laboratorio, se debe tener cuidado al recolectar, manipular, y almacenar muestras para el análisis de diagnóstico de vitaminas y minerales.

Résumé - Influence de la manipulation pré-analytique d'échantillons biologiques pour l'analyse des vitamines liposolubles

Objectif: Déterminer comment la manipulation des échantillons affecte l'analyse nutritionnelle des vitamines et minéraux liposolubles.

Matériels et méthodes: Dans l'expérience 1, le sang a été prélevé dans des tubes pour plasma ou sérum et exposé à 4 heures de lumière ou enveloppé dans du papier d'aluminium pour le protéger de la lumière. Dans l'expérience 2, le sang a été prélevé aux heures 0, 1, 2, 3, 4, 6, et 12 après la consommation d'aliments. Dans l'expérience 3, les vitamines et les minéraux ont été évalués dans des échantillons de sang à des degrés divers d'hémolyse. L'expérience 4 a évalué des échantillons de foie exposés à diverses températures pendant jusqu'à 12 heures. Dans l'expérience 5, des échantillons de sérum et de foie ont été traités le jour même, 1 jour après,

SE, LLG: Department of Animal Science, Iowa State University, Ames, Iowa.

Corresponding author: Dr Laura Greiner, 806 Stange Rd, Ames, IA 50011; **greinerl@iastate.edu**.

Elefson S, Greiner LL. Influence of biological sample pre-analytical manipulation for fat-soluble vitamin analysis. *J Swine Health Prod*. 2023;31(4):186-192. **https://doi.org/10.54846/jshap/1348**

ou 2 jours après la collecte et placés ensuite dans des glacières avec des blocs réfrigérants.

Résultats: Il y avait une différence significative ($P < .05$) pour l'interaction du type de tube et de l'exposition à la lumière pour la vitamine D (25-hydroxyvitamine D_3) et une tendance ($P < .10$) pour une interaction du type de tube et de l'exposition à la lumière pour la vitamine A (rétinol). L'expérience 2 a révélé que les concentrations de vitamines sériques changeaient après la consommation d'aliments à la fois de manière linéaire et quadratique. L'alpha-tocophérol a culminé à 4 heures après la consommation des repas, tandis que le rétinol a culminé à 6 heures. Dans l'expérience 3, le degré d'hémolyse a affecté ($P < .05$) la concentration en nutriments. Les expériences 4 et 5 n'ont montré aucune différence ($P > .05$) dans la dégradation du rétinol et de l'alpha-tocophérol.

Implication: Étant donné que de nombreux facteurs pré-analytiques peuvent affecter les résultats de laboratoire, des précautions doivent être prises lors de la collecte, de la manipulation, et du stockage des échantillons pour l'analyse diagnostique des vitamines et des minéraux.

About 40% to 65% of errors in laboratory procedures occur in the pre-analytical phase,[1] including sample collection. Dependent upon the nutrient in question, a blood sample can sometimes determine nutrient deficiency or toxicity without having to euthanize animals for tissue sample collection.[2] Across many published references, serum or plasma samples have been analyzed to determine the vitamin A concentrations in pigs[3-6] without a consistent sampling protocol. However, serum and plasma are uniquely different biologically. Serum results from fibrin clots that form in the blood and has lower protein and fewer platelets, erythrocytes, and leukocytes than plasma.[7] Research should be conducted before blood sampling to ensure that the correct collection tube type and handling methods are being used to prevent a poor diagnostic sample. For example, vitamin A is known to be a light-sensitive nutrient, and the sample is typically kept from light during lab analyses.[8] Plasma collection tubes contain anticoagulants to prevent blood from clotting. Anticoagulants may affect some lab analyses.[9] For example, a potassium-based anticoagulant could increase the potassium levels that are measured in the plasma.

The timing of blood collection may be important when assessing serological nutrient levels. While most pigs receive an *ad libitum* diet, they are not continuously eating all day. After the consumption of a meal, digestion, absorption, and redistribution of the consumed nutrients occur. When the nutrients enter the bloodstream, there is potential for a spike of that nutrient in circulation. Therefore, the time between last feed consumption and sample collection affects nutrient levels in the blood. Hemolysis is the destruction of red blood cells and can occur when blood samples undergo significant shear-force pressure, which has been shown to cause hemolysis.[10] Often this is seen when blood tubes are violently shaken or if blood is collected via a syringe and then forced through a needle into a vacutainer tube. When blood undergoes hemolysis, zinc and iron concentrations significantly increase in the analyzed serum or plasma.[11] Furthermore, high levels of hemolysis also result in increased chloride, magnesium, potassium, phosphorous, and total protein in analyzed samples.[12] Analyses for other nutrients, such as bilirubin, uric acid, cholesterol, and triglycerides, are also affected by hemolysis,[12] but fall outside the scope of this paper.

The liver is another tissue collected for analytical evaluations, as the liver serves as a main store of many vitamins and minerals.[13] The liver should be frozen as soon as possible to avoid degradation of any organic compounds, including vitamins.[13] While explored more in feedstuffs, vitamins tend to be sensitive to high temperatures, light exposure, and pH changes.[14] Thus, freezing liver samples in a dark environment until the time of analysis is the most ideal for nutrient analysis. Keeping liver samples frozen becomes problematic if they need to be mailed for submission to a veterinary diagnostic laboratory, as weather and human error can cause package delivery to be postponed during overnight shipping.

These sampling and handling techniques that can affect vitamin and mineral analysis in samples were addressed in 5 experiments. The overall objective of the experiments was to better understand how sample collection, handling, and storage affects nutrient analysis. Experiment 1 evaluated whether vitamin concentrations were different when either serum or plasma were collected and how vitamin concentrations may change during light exposure. Experiment 2 assessed circulating blood nutrient concentrations post meal consumption. Experiment 3 compared vitamin concentrations in hemolyzed versus non hemolyzed plasma. Experiment 4 evaluated the vitamin and mineral degradation rate in the pig liver over 12 hours when held at various temperatures. Experiment 5 evaluated the impact of delayed sample processing on vitamin levels in serum and the liver.

Animal care and use

All procedures in this study adhered to guidelines for the ethical and humane use of animals for research and were approved by the Institutional Animal Care and Use Committee at Iowa State University (No. 20-087, 22-154, and 20-123).

Materials and methods

Metabolites chosen for analysis across studies related back to previous work conducted to address questions about sample collection that specifically evaluated a nutrient in question. Unless otherwise stated, pigs were group housed with *ad libitum* access to feed and water.

Experiment 1. Plasma vs serum with and without light exposure

A total of 4 blood samples were taken from 8 pigs (approximately 6 months old, 115-120 kg, $n = 4$ barrows and 4 gilts; PIC 337 × 1050 genetics) via jugular venipuncture. Two blood samples were collected for serum using 10-mL, red-top tubes without gel separator (BD Vacutainer; Becton Dickinson) and 2 were collected for plasma using 10-mL tubes with tripotassium ethylenediaminetetraacetic acid (K3-EDTA; BD Vacutainer; Becton Dickinson). One of each type of blood sample was exposed to light prior to centrifugation, while the other blood tube was wrapped in aluminum foil immediately after the blood sample was collected to keep light from the sample. All samples were chilled by laying the samples on ice until the time of processing. Light-exposed samples were exposed for 4 hours to light from 2 fluorescent bulbs (SYLVANIA, Supersaver Deluxe Cool White F34CWX/SS, 34w, 4100K, 1925 lumens, 1219.2 mm; and SYLVANIA, Ecologic, Designer F34/D35/SS/ECO, 34w, 3500K, 2800 lumens, 1219.2 mm). The samples were placed approximately 3 m from the light source and rotated every hour to ensure complete exposure of the sample to the light. The general light intensity in the room

was approximately 102.3 lux measured by a luxmeter (AOPUTTRIVER; Model: AP-881D) in the location of the sample. Direct sunlight was avoided to better replicate the farm's light source. Blood was centrifuged (Sorvall Legend XFR, ThermoFisher Scientific) at 2000*g* for 10 minutes at 4°C. Samples were stored at -80°C until further analysis.

Experiment 2. Pharmacokinetics of vitamins A and E in serum after a meal

Eight gilts (mean [SD] weight: 98 [5] kg; PIC 337 × 1050 genetics) were individually housed in pens and fasted for 12 hours. Prior to a meal, a blood sample was taken via jugular venipuncture using a 10-mL, red-top serum tube without a gel separator. Water was provided *ad libitum* throughout the study. A diet was provided at a level of 4% of the pig's body weight and consisted of a standard corn and soybean meal-based diet that met or exceeded NRC requirements.[15] Pigs were allowed access to feed for 1 hour, and then the feed was removed from the pen. Blood samples were taken at hours 1, 2, 3, 4, 6, and 12 after collecting the initial blood sample. After the last blood sample, feed was returned to the animal. All blood was allowed to clot at room temperature (approximately 20°C) for less than 4 hours before being moved to 4°C. All samples were centrifuged (2000*g* for 10 minutes at 4°C) within 6 hours of collection and stored at -80°C until further analysis.

Experiment 3. Hemolysis

Six gilts (approximately 90 kg; PIC 337 × 1050 genetics) on a common corn and soybean meal diet that met or exceeded NRC requirements[15] were sampled via jugular venipuncture using two, 10-mL plasma tubes (K3-EDTA blood tubes). The 2 blood tubes were re-aliquoted into 3 test tubes, making sure to mix blood from each collection blood tube using a transfer pipette (CAT: 13-711-7M; Fisher Scientific). One aliquot was centrifuged without any manipulation, representing a low level of hemolysis. The second aliquot was drawn into a sterile 10-mL syringe with a 26-gauge, 0.5-inch needle and expelled 5 times, which was defined as a medium level of hemolysis. Finally, the last aliquot was subjected to sonication for 5 seconds (Model: GE 130PB; outage = 02; Cole Parmer), which was defined as a high level of hemolysis. All blood was centrifuged at 2000*g* for 10 minutes at 4°C. The plasma was isolated from the sample and stored at -80°C until further analysis.

Experiment 4. Liver degradation

Liver samples were collected from 6 gilts (approximately 90 kg; PIC 337 × 1050 genetics) fed a common corn and soybean meal diet with vitamin inclusion that met or exceeded NRC recommendations.[15] Gilts were euthanized via captive bolt followed by exsanguination. The entire left lobe of the liver was divided into 10 equal sections, placed in Whirl-Pak bags (15.24 cm × 22.86 cm) that were then subjected to different temperatures for different lengths of time. One liver section was immediately snap frozen and stored at -80°C until further analysis. Other sections of the liver were stored in the freezer (-20°C), the refrigerator (4°C), or at room temperature (20°C) for either 3, 6, or 12 hours. At the designated time, the section of the liver was moved to -80°C for further analysis of vitamin concentrations.

Experiment 5. Long-term degradation

Blood was collected into 3 solid red-top blood tubes (10 mL) from 6 barrows (approximately 10 kg; PIC 337 × 1050 genetics) during exsanguination. The right medial lobe of the liver was collected and divided into 3 equal sections and stored in Whirl-Pak bags (15.24 cm × 22.86 cm). Blood and liver samples were placed into a Styrofoam cooler with 4 ice packs (ThermoSafe PolarPack; 13.97 cm × 15.24 cm; Sonoco) and stored until time of processing. On the designated day (day of collection [D0], 1 day after collection [D1], and 2 days after collection [D2]), 1 blood tube and 1 liver sample were removed from the cooler. The blood sample was centrifuged at 2000*g* for 10 minutes at 4°C. The serum was separated from the red blood cells and stored in 1.5-mL tubes (CAT: 05-408-129; Fisher Scientific). The serum and liver sections were stored at -80°C until further analysis.

Sample analysis

All samples were analyzed for concentrations of vitamins A, E, D, or a combination of the 3, and trace minerals where appropriate, at Iowa State University's Veterinary Diagnostic Laboratory as described by Greiner et al.[2] Vitamin A was analyzed for the metabolite retinol, vitamin E was analyzed for the metabolite alpha-tocopherol, and vitamin D was analyzed for the metabolite 25-hydroxyvitamin D_3.

Statistical analysis

All data were analyzed using the GLIMMIX procedure in SAS 9.4 (SAS Institute) except where otherwise indicated. For all statistical analyses, the animal was the experimental unit and used for repeated measures. Least squares means were reported with a Tukey adjustment, and $P \leq .05$ were considered significant, while $.05 < P \leq .10$ were considered a tendency. Data analysis for each experiment varied and therefore additional statistical analysis conducted is further described here.

Experiment 1. Fixed effects include blood tube and light exposure interaction and sex.

Experiment 2. The IML procedure was used to obtain contrast coefficients to account for the unequal spacing in sample collection. Time was a fixed effect within the model.

Experiment 3. The degree of hemolysis was a fixed effect. Observations for iron and manganese were log-transformed for normality and converted back for reporting. Additionally, there was an outlier in the iron analysis in which one sample in the medium hemolysis group was more than 3 standard deviations from the mean of the other samples within the treatment. The observation was removed to obtain normal data for analysis using the Shapiro Wilks test.

Experiment 4. Fixed effects include temperature and time interaction.

Experiment 5. Time was the fixed effect within the model. One pig was removed from the analysis as alpha-tocopherol in the serum was more than 3 standard deviations below the mean of other samples from the same treatment and the analyzed level was 0.2 ppm when other measurements for the same pig were approximately 2.0 ppm.

Results

Plasma vs serum with and without light exposure

The concentration of vitamin A (retinol) in either plasma or serum tubes was not significantly different ($P > .05$, Table 1) in relation to light exposure. However, there was a tendency ($P = .07$) for retinol to be lower in serum tubes with no light exposure compared to other collection methods (0.20 ppm vs 0.21 ppm, respectively). Retinol tended ($P = .09$) to be higher for barrows than

Table 1: Vitamin A (retinol), D (25-hydroxyvitamin D_3), and E (alpha-tocopherol) analysis in grow-finish swine serum and plasma with or without light exposure*

Parameter	Barrow				Gilt				SEM	P				
	Serum		Plasma		Serum		Plasma							
	Light	No light	Light	No light	Light	No light	Light	No light		Exposure	Tube	Sex	Exposure × Tube	Exposure × Tube × Sex
Retinol, ppm	0.22	0.21	0.22	0.23	0.20	0.19	0.19	0.19	0.009	.29	.14	.09	.07	.29
25-hydroxyvitamin D_3, ng/mL	44	44	40	42	23	23	21	22	5.3	.08	< .001	.04	.03	.77
Alpha-tocopherol, ppm	1.40	1.40	1.33	1.38	1.43	1.43	1.43	1.28	0.141	.65	.26	.95	.65	.37

* Blood tubes were either wrapped in aluminum foil (no light) or exposed for 4 hours to light from a fluorescent bulb immediately after sample collection and prior to centrifugation.

for gilts (0.22 ppm vs 0.19 ppm, respectively). There was no difference ($P > .05$, Table 1) in blood tube type, light exposure, the interaction between the two, or sex for vitamin E (alpha-tocopherol). There was an interaction for Vitamin D (25-hydroxyvitamin D_3) between blood tube type and light exposure ($P = .03$) in which serum blood tubes that were both exposed to light and not (34 ng/mL of 25-hydroxyvitamin D_3 for both serum samples) were higher than both plasma samples, but plasma not exposed to light was higher than plasma exposed to light (32 ng/mL and 30 ng/mL, respectively). Vitamin D (25-hydroxyvitamin D_3) had a tendency ($P = .08$, Table 1) to be higher in tubes that were not exposed to light compared to tubes that were exposed to light (33 ng/mL vs 32 ng/mL, respectively). Additionally, 25-hydroxyvitamin D_3 was ($P < .001$) higher in serum tubes versus plasma tubes (34 ng/mL vs 31 ng/mL, respectively). Furthermore, 25-hydroxyvitamin D_3 was higher ($P = .04$) in barrows than in gilts (43 ng/mL vs 22 ng/mL, respectively).

Pharmacokinetics of vitamins A and E in serum after a meal

Over time, the vitamin serum concentrations had linear and quadratic effects ($P < .05$, Table 2). Alpha-tocopherol peaked at hour 4, whereas retinol peaked at hour 6.

Hemolysis

Differences found across all parameters analyzed were dependent upon the level of sample hemolysis and the analyzed nutrient. The visual difference of the level of hemolysis is shown in Figure 1. There was no difference ($P > .05$, Table 3) between the low and medium levels of sample hemolysis for alpha-tocopherol, calcium, copper, magnesium, manganese, phosphorous, potassium, selenium, and zinc. However, there was a difference ($P < .05$) between the previously listed parameters and the high level of sample hemolysis. For iron and molybdenum, there was a difference ($P < .01$) between all degrees of sample hemolysis. At a low level of sample hemolysis, retinol was different ($P < .05$) from the medium and high levels of sample hemolysis. However, the medium and high level of sample hemolysis was not different from each other ($P > .05$).

Liver degradation

There were no differences ($P > .05$, Table 4) in the liver retinol and alpha-tocopherol levels over 12 hours at varying temperatures.

Long-term degradation

There were no differences ($P > .05$, Table 5) in retinol and alpha-tocopherol concentrations in serum and liver samples when processed either the day of, 1 day after, or 2 days after collection.

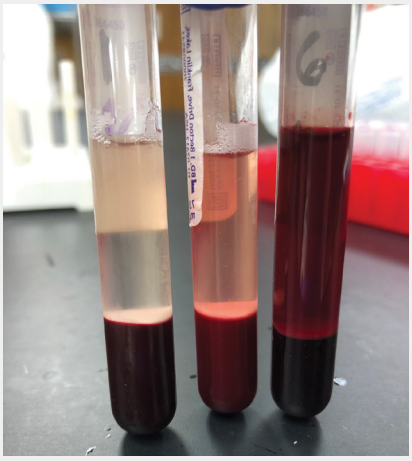
Discussion

From the differences detected among the blood tubes and light exposure for vitamin analysis, results received from a diagnostic laboratory may be influenced by the blood tube type, light exposure, or both. Vitamins A, D, and E in feedstuffs have been reported to have light sensitivity,[16] but there has been little documentation if this phenomenon occurs in biological samples. It has been recommended that collected blood should not be stored in areas of direct sunlight.[17] The differences observed with vitamin D metabolites across different blood tubes and light exposure could be due to the metabolites in the blood reacting with the anticoagulant, as plasma samples had lower 25-hydroxyvitamin D_3 than serum. However, vitamin D metabolite levels in blood collected with different types of blood tubes measured by liquid chromatography-tandem-mass spectrometry have been inconsistent across studies. Zelzer et al[18] summarized studies that reported conflicting findings concerning the impact of plasma or serum blood tube use to analyze vitamin D metabolites. While some studies reported no differences between serum or plasma, others found that either serum or plasma had higher levels of vitamin D metabolites. Studies have also reported that blood tube types can impact vitamin and mineral analysis. Blood tubes with royal blue caps are recommended for mineral analysis. These tubes do not contain trace minerals in the materials used to make them, while other blood tubes may contain minerals that will interfere with the mineral analysis.[19] Thus, it is vital to communicate with the diagnostic laboratory how the sample was collected on the farm or consult with the diagnostic laboratory prior to sample collection to ensure the sample is taken correctly. Vitamin D metabolites were significantly lower in females than males; however, the analyzed levels

Table 2: Pharmacokinetics of vitamin A (retinol) and E (alpha-tocopherol) in circulation after grow-finish gilts consumed a common corn and soybean-based diet

	Hour post consumption								*P*			
Parameter	**0**	**1**	**2**	**3**	**4**	**6**	**12**	**SEM**	**Hour**	**Linear**	**Quadratic**	**Cubic**
Retinol, ppm	0.24	0.24	0.24	0.24	0.24	0.25	0.22	0.009	.02	.02	.02	.21
Alpha-tocopherol, ppm	2.2	2.3	2.2	2.2	2.5	2.0	1.8	0.191	< .001	< .001	.03	.10

Figure 1: From left to right, blood samples with low, medium, and high levels of hemolysis. Low hemolysis: sample was not manipulated after collection; medium hemolysis: sample was subjected to aspiration by drawing whole blood into a sterile 10-ml syringe with a 26-gauge, 0.5-inch needle and expelled 5 times; high hemolysis: whole blood was subjected to sonication for 5 seconds.



were similar to previously reported vitamin D levels (approximately 26 ng/mL).[20] Additionally, it has been reported that sows have lower serum vitamin D levels than boars,[20] so vitamin D metabolite differences seen in the current study could be due to sexual maturation.

The results of this study suggest active absorption and recirculation of vitamins A and E in the pig after a meal. If a pig is limit fed, sampling for retinol and alpha-tocopherol should be done before the pig consumes feed to avoid any nutritional spikes. This study showed a spike in retinol and alpha-tocopherol at 6 and 4 hours, respectively, after a meal. However, diet composition can alter the time it takes for lipophilic food components to be absorbed.[21] It is generally accepted that fat-soluble vitamins are incorporated into micelles[22] and absorbed with fat in the upper half of the small intestine.[23] Factors such as the bioavailability of lipids to be emulsified into micelles can impact the time it takes for the fat to be absorbed[21] and, subsequently, the time to absorb fat-soluble vitamins. Sampling before the animal eats helps ensure that there is no spike of nutrients traveling through the blood at the time the sample is taken, although this may result in reporting of lower levels of nutrients. If sampling a limit-fed pig, it is best to note the time the animal last ate and when the sample is taken to account for any potential highs and lows that might appear in a diagnostic report.

There is a wide range of hemolysis that can exist during sample collection,[24] and exploring all degrees of hemolysis falls outside the scope of the study reported here. Three levels of hemolysis were selected for discussion within this study. Sonicating the sample allowed for extreme hemolysis, ensuring any potential differences in the analyses would be detected. Spectrophotometric interferences with other laboratory methods can be produced from hemolyzed samples,[25] and thus it is best to avoid hemolysis to ensure laboratory methods are executed properly. Hemolysis results from this study were similar to previous studies where an increase in iron,[11] zinc,[11] potassium,[1] and phosphorous[1] and a decrease in vitamin E were observed.[26] To ensure blood sample results are accurate, it is recommended to avoid any hemolysis of the blood sample. Reports of altered nutrient analysis have been made with even mild hemolysis,[1] which was also observed with the results of this study. A syringe has the potential to create enough pressure to cause hemolysis when used with a large bore needle.[27] Thus, care should be taken if blood samples are collected using a needle and syringe to avoid hemolysis.

Organic compounds, such as vitamins, will degrade over time.[13] However, low temperatures minimize the occurrence of the degradation process.[28] It is a common practice to keep samples on ice and freeze them as soon as possible as there is much still unknown about vitamin degradation in collected biological samples. In this study, storing samples at room temperature (approximately 20°C) for 12 hours did not appear to impact degradation of the tested vitamins. The lack of difference in detectable retinol and alpha-tocopherol concentrations within the liver would suggest that the vitamins are stable for a period after tissue degradation has started.

Retinol and alpha-tocopherol concentrations of tissues left in a Styrofoam cooler for up to 2 days were not different from measurements made on the same day of collection. The authors hypothesize that the ice packs created a cold enough environment in the cooler to delay any significant degradation of retinol and alpha-tocopherol in the biological samples. Whole blood has been reported to be held at room temperature (approximately 22°C) for platelet analysis. Leaving whole blood at room temperature is recommended for facilities that are designed to process bulk blood, such as from blood donors, where the room temperature is kept at 22°C (± 2°C).[17] Styrofoam coolers are made from a polystyrene foam, which is listed as a component used in most insulated containers used to transport blood.[17] A well-insulated container can help prevent excessive environmental heat from warming the samples within the container.[17] Once more, it is recommended that samples be kept on ice and frozen as soon as possible. Organic compounds will degrade over time,[13] but keeping the tissue in a cold environment creates unfavorable conditions for degradation.[28] The coolers and ice packs in this study were stored at ambient temperatures over 2 days. Coolers transported in non-temperature-controlled environments may experience a higher degree of degradation of organic compounds, especially during summer when temperatures are warmer.

Table 3: Analysis of vitamin A (retinol), E (alpha-tocopherol), and trace minerals in hemolyzed blood of grow-finish swine

	Level of hemolysis*				
Parameter	**Low**	**Medium**	**High**	**SEM**	***P***
Vitamins					
Retinol, ppm	0.26[a]	0.24[b]	0.23[b]	0.014	< .001
Alpha-tocopherol, ppm	1.78[a]	1.55[a]	1.00[b]	0.101	< .001
Minerals					
Calcium, ppm	115.1[a]	111.9[a]	95.8[b]	2.38	< .001
Copper, ppm	1.8[a]	1.7[a]	1.6[b]	0.13	.005
Iron, ppm	1.8[c]	2.9[b]	159.2[a]	1.04	< .001
Magnesium, ppm	18.8[b]	18.9[b]	38.2[a]	3.04	< .001
Manganese, ppb	5[b]	5[b]	8[a]	1.1	.02
Molybdenum, ppb	13[a]	12[b]	11[c]	0.4	< .001
Phosphorus, ppm	59.2[b]	58.2[b]	125.9[a]	3.48	< .001
Potassium, ppm	1107.1[b]	1070.3[b]	1725.5[a]	30.35	< .001
Selenium, ppb	280[b]	268[b]	359[a]	11.7	< .001
Zinc, ppm	4.2[b]	4.1[b]	4.8[a]	0.22	< .001

* Low hemolysis: sample was not manipulated after collection; medium hemolysis: sample was subjected to aspiration by drawing whole blood into a sterile 10-mL syringe with a 26-gauge, 0.5-inch needle and expelled 5 times; high hemolysis: whole blood was subjected to sonication for 5 seconds.

[a,b,c] For each parameter measured, differing superscripts indicate a statistical difference between hemolysis levels, $P < .05$.

Table 4: Grow-finish swine liver vitamin A (retinol) and E (alpha-tocopherol) concentrations after exposure to different temperatures for different periods of time

	Temperature*											
	Liquid N_2	**-20°C**			**4°C**			**20°C**				
Parameter	**0h**	**3h**	**6h**	**12h**	**3h**	**6h**	**12h**	**3h**	**6h**	**12h**	**SEM**	***P***
Retinol, ppm	44	46	42	45	44	45	46	47	45	47	4.7	.80
Alpha-tocopherol, ppm	9.8	10.2	10.0	9.7	9.8	9.8	10.1	9.7	10.0	9.7	0.93	.93

* Liver samples were either snap frozen in liquid nitrogen, stored in the freezer(-20°C), stored in the refrigerator (4°C), or stored at room temperature (20°C) for the respective amount of time.

Table 5: Long term degradation of nursery pig liver and serum levels of vitamin A (retinol) and E (alpha-tocopherol) left in Styrofoam coolers* for either 0, 1, or 2 days after collection

	Days post collection				
Parameter	**0**	**1**	**2**	**SEM**	***P***
Serum, ppm					
Retinol	0.26	0.26	0.27	0.018	.28
Alpha-tocopherol	2.20	2.36	2.28	0.190	.16
Liver, ppm					
Retinol	12	11	12	0.6	.77
Alpha-tocopherol	1.74	2.32	2.08	0.295	.20

* Styrofoam coolers contained 4 ice packs (ThermoSafe PolarPack; 13.97 cm × 15.24 cm; Sonoco).

It is best to ensure that the correct tube is used to collect blood for the analysis in question. The time in which blood samples are taken should be considered when collecting from limit-fed animals to potentially explain any high or low values that could appear in a diagnostic report, and all blood samples should be collected directly into a blood tube to avoid the potential of hemolysis. While both liver and blood samples do not show significant retinol and alpha-tocopherol degradation after 2 days in a cooler with ice packs, storing and processing samples as quickly as possible is still recommended.

Implications

Under the conditions of this study:

- Blood tube and timing of collection can affect blood vitamin analysis.
- Samples can sit for up to 2 days with no difference in vitamin concentrations.
- Hemolysis will affect vitamin and mineral analyses in blood.

Acknowledgments

Conflict of interest

None reported.

Disclaimer

Scientific manuscripts published in the *Journal of Swine Health and Production* are peer reviewed. However, information on medications, feed, and management techniques may be specific to the research or commercial situation presented in the manuscript. It is the responsibility of the reader to use information responsibly and in accordance with the rules and regulations governing research or the practice of veterinary medicine in their country or region.

References

1. Bhargava S, Singla P, Manocha A, Kankra M, Sharma A, Ahirwar A, Ralhan R, Thapliyal U, Mehra P. The hemolyzed sample: To analyse or not to analyse. *Indian J Clin Biochem*. 2020;35(2):232-238. **https://doi.org/10.1007/s12291-019-00821-4**

2. Greiner L, Elefson S, Radke S, Hagen C, Humphrey D, Becker S. A survey of vitamin and trace mineral ranges for diagnostic lab reporting from conventionally raised swine. *J Swine Health Prod*. 2022;30(5):282-291. **https://doi.org/10.54846/jshap/1286**

3. Ching S, Mahan DC, Wiseman TG, Fastinger ND. Evaluating the antioxidant status of weanling pigs fed dietary vitamins A and E. *J Anim Sci.* 2002;80:2396-2401. **https://doi.org/10.1093/ansci/80.9.2396**

4. Jang YD, Rotering MJ, Isensee PK, Rinholen KA, Boston-Denton CJ, Kelley PG, Stuart RL. Distribution of injected fat-soluble vitamins in plasma and tissues of nursery pigs. *Asian-Australas J Anim Sci*. 2020;33(12):1985-1990. **https://doi.org/10.5713/ajas.19.0987**

5. Alam BS, Brown LR, Alam SQ. Influence of dietary fats and vitamin E on plasma and hepatic vitamin A and beta-carotene levels in rats fed excess beta-carotene. *Nutr Cancer*. 1990;14:111-116. **https://doi.org/10.1080/01635589009514084**

6. Anderson LE, Myer RO, Brendemuhl JH, McDowell LR. The effect of excessive dietary vitamin A on performance and vitamin E status in swine fed diets varying in dietary vitamin E. *J Anim Sci*. 1995;73:1093-1098. **https://doi.org/10.2527/1995.7341093x**

7. Issaq HJ, Xiao Z, Veenstra TD. Serum and plasma proteomics. *Chem Rev*. 2007;107(8):3601-3620. **https://doi.org/10.1021/cr068287r**

8. Nierenberg DW, Lester DC. Determination of vitamins A and E in serum and plasma using a simplified clarification method and high-performance liquid chromatography. *J Chromatogr*. 1985;345:275-284. **https://doi.org/10.1016/0378-4347(85)80165-1**

9. Benjamin MM. *Outline of Veterinary Clinical Pathology*. 3rd ed. The Iowa State University Pess; 1978.

10. Nevaril CG, Lynch EC, Alfrey Jr CP, Hellums JD. Erythrocyte damage and destruction induced by shearing stress. *J Lab Clin Med*. 1968;71:784-790.

11. Killilea DW, Rohner F, Ghosh S, Otoo GE, Smith L, Siekmann JH, King JC. Identification of a hemolysis threshold that increases plasma and serum zinc concentration. *J Nutr*. 2017;147(6):1218-1225. **https://doi.org/10.3945/jn.116.247171**

12. Koseoglu M, Hur A, Atay A, Çuhadar S. Effects of hemolysis interferences on routine biochemistry parameters. *Biochem Med (Zagreb)*. 2011;21(1):79-85. **https://doi.org/10.11613/bm.2011.015**

13. Combs Jr GF. *The Vitamins: Fundamental Aspects in Nutrition and Health*. 4th ed. Academic Press; 2012.

*14. Menegat MB, Goodband RD, DeRouchey JM, Tokach MD, Woodworth JC, Dritz SS. Vitamin Sources for Swine Diet. Kansas State University Swine Nutrition Guide. Published 2019. Accessed October 4, 2022. **https://www.asi.k-state.edu/extension/swine/swinenutritionguide/pdf/KSU%20Vitamin%20Sources%20for%20Swine%20Diets%20fact%20sheet.pdf**

15. National Research Council. *Nutrient Requirements of Swine*. 11th ed. National Acadedmy Press; 2012.

*16. Menegat MB, Goodband RD, DeRouchey JM, Tokach MD, Woodworth JC, Dritz SS. Vitamin stability. Kansas State University Swine Nutrition Guide. Published 2019. Accessed November 14, 2022. **https://www.asi.k-state.edu/extension/swine/swinenutritionguide/general_nutrition_principles/vitaminstability.html**

17. Hardwick J. Blood storage and transportation. *ISBT Sci Ser*. 2008;3:177-196. **https://doi.org/10.1111/j.1751-2824.2008.00196.x**

18. Zelzer S, Goessler W, Herrmann M. Measurement of vitamin D metabolites by mass spectrometry, an analytical challenge. *J Lab Precis Med*. 2018;3:99. **https://doi.org/10.21037/jlpm.2018.11.06**

19. Corn R. Trace Mineral Testing. Kansas State Veterinary Diagnostic Laboratory. Published April 2019. Accessed November 14, 2022. **https://www.ksvdl.org/resources/news/diagnostic_insights_for_technicians/april2019/trace-mineral-testing.html**

20. Arnold J, Madson DM, Ensley SM, Goff JP, Sparks C, Stevenson GW, Crenshaw T, Wang C, Horst RL. Survey of serum vitamin D status across stages of swine production and evaluation of supplemental bulk vitamin D premixes used in swine diets. *J Swine Health Prod*. 2015;23(1):28-34.

21. McClements DJ, Decker EA, Park Y, Weiss J. Designing food structure to control stability, digestion, release and absorption of lipophilic food components. *Food Biophys*. 2008;3(2):219-228. **https://doi.org/10.1007/s11483-008-9070-Y**

22. Iqbal J, Hussain MM. Intestinal lipid absorption. *Am J Physiol Endocrinol Metab*. 2009;296:1183-1194. **https://doi.org/10.1152/ajpendo.90899.2008**

23. Reboul E. Absorption of vitamin A and carotenoids by the enterocyte: Focus on transport proteins. *Nutrients*. 2013;5(9):3563-3581. **https://doi.org/10.3390/nu5093563**

24. Ni J, Zhu W, Wang Y, Wei X, Li J, Peng L, Zhang K, Bai B. A reference chart for clinical biochemical tests of hemolyzed serum samples. *J Clin Lab Anal*. 2021;35(1):e23561. **https://doi.org/10.1002/jcla.23561**

25. Carraro P, Servidio G, Plebani M. Hemolyzed specimens: A reason for rejection or a clinical challenge? *Clin Chem*. 2000;46(2):306-307. **https://doi.org/10.1093/clinchem/46.2.306**

26. Hooser SB, McCarthy JM, Wilson CR, Harms JL, Stevenson G, Everson RJ. Effects of storage conditions and hemolysis on vitamin E concentrations in porcine serum and liver. *J Vet Diagn Invest*. 2000;12:365-368. **https://doi.org/10.1177/104063870001200412**

27. Sharp MK, Mohammad SF. Scaling of hemolysis in needles and catheters. *Ann Biomed Eng*. 1998;26:788-797. **https://doi.org/10.1114/1.65**

*28. Ahn HK, Glanville TD, Crawford BP, Koziel JA, Akdeniz N. Evaluation of the biodegradability of animal carcasses in passively aerated bio-secure composting system. ASABE Paper No. 074037. In: *ASABE Annual International Meeting*. 2007

* Non-refereed references.

Nutritional strategies to reduce growth of pigs during emergency situations

Madie R. Wensley, MS; Mike D. Tokach, PhD; Jason C. Woodworth, PhD; Robert D. Goodband, PhD; Joel M. DeRouchey, PhD; Jordan T. Gebhardt, DVM, PhD

Summary

Multiple feeding strategies have been shown to reduce growth in emergency situations. Feeding low protein diets decreased average daily gain (ADG) up to 71% depending on the degree of restriction and resulted in decreased carcass leanness. Feeding excess methionine decreased ADG up to 67%, with limited effects on carcass leanness. Feeding methionine in the diet above 2% may result in body weight loss. Feeding calcium chloride or ammonium chloride decreased ADG up to 98% depending on the dietary electrolyte imbalance imposed and can result in leaner carcasses and potentially poorer meat quality as measured by color, pH, and tenderness.

Keywords: swine, growing-finishing pig, growth rate, nutrition, slow down

Received: May 26, 2022
Accepted: December 21, 2022

Resumen - Estrategias nutricionales para reducir el crecimiento de los cerdos durante situaciones de emergencia

Se ha demostrado que diferentes estrategias de alimentación reducen el crecimiento en situaciones de emergencia. Alimentar con dietas bajas en proteína disminuyó la ganancia diaria promedio (GMD) hasta en un 71% según el grado de restricción, y repercutió en una disminución del musculo de la canal. La alimentación con exceso de metionina disminuyó la GMD hasta en un 67%, y tuvo efectos limitados en la composición de músculo de la canal. Alimentar con metionina en la dieta por arriba del 2% puede provocar una pérdida de peso corporal. Alimentar con cloruro de calcio o cloruro de amonio redujo la GMD hasta en un 98% dependiendo del desequilibrio de electrolitos impuesto en la dieta, y puede dar como resultado canales más magras, y una calidad de la carne potencialmente menor medida por el color, el pH, y la suavidad.

Résumé - Stratégies nutritionnelles pour réduire la croissance des porcs durant des situations d'urgence

De nombreuses stratégies nutritionnelles ont été démontrées comme pouvant réduire la croissance lors de situations d'urgence. En nourrissant avec une diète faible en protéines, on a réduit le gain quotidien moyen (ADG) jusqu'à 71% selon le degré de restriction et obtenu une diminution de la maigreur de la carcasse. En donnant un excès de méthionine on diminua l'ADG jusqu'à 67%, avec des effets limités sur la maigreur de la carcasse. Donner plus de 2% de méthionine dans la diète pourrait résulter en une perte de poids corporel. Donner du chlorure de calcium ou du chlorure d'ammonium diminua l'ADG jusqu'à 98% selon le débalancement électrolytique alimentaire imposé et peut résulter en des carcasses plus maigres et potentiellement d'une qualité de viande inférieure telle que mesurée par la couleur, le pH, et la tendreté.

During emergency situations, such as disease outbreaks in pigs or humans, decreased harvest capacity, or when animal movement is restricted, slowing the growth rate of growing and finishing pigs through dietary formulation may be necessary. Although this is not common practice, knowing how to respond and to what degree the response will impact pig performance is important. When harvest capacity was restricted at the onset of the COVID-19 pandemic, several feeding and management recommendations were made available to swine producers to reduce the growth of pigs.[1,2] While this practice tip does not serve to replace the previous recommendations, the goal is to add to the existing information by providing expected reductions in growth that are associated with the different feeding approaches. This practice tip will also provide important insight on how these feeding strategies are expected to affect carcass characteristics. The advantages and disadvantages associated with each strategy can be found on the Iowa Pork Industry Center website.[3] The references used herein are from experiments conducted in response to the COVID-19 pandemic. However, the approaches used may serve as a tool for future situations that prevent or reduce animal movement.

Nutritional strategies

Low protein diets

Low protein diets can be achieved through the partial or complete replacement of soybean meal and feed-grade amino acids with corn. The elimination

MRW, MDT, JCW, RDG, JMD: Department of Animal Sciences and Industry, Kansas State University, Manhattan, Kansas.

JTG: Department of Diagnostic Medicine/Pathobiology, College of Veterinary Medicine, Kansas State University, Manhattan, Kansas.

Corresponding author: Dr Jordan T. Gebhardt, Department of Diagnostic Medicine/Pathobiology, Kansas State University, Manhattan, KS; Email: **jgebhardt@vet.k-state.edu**.

Wensley MR, Tokach MD, Woodworth JC, Goodband RD, DeRouchey JM, Gebhardt JT. Nutritional strategies to reduce growth of pigs during emergency situations. *J Swine Health Prod*. 2023;31(4):193-196. **https://doi.org/10.54846/jshap/1320**

of soybean meal and feed-grade amino acids significantly reduces the crude protein and lysine (Lys) concentration of the diet. Across 4 recent experiments, feeding diets with 89% to 98% corn resulted in an approximately 30% to 75% reduction in standardized ileal digestible (SID) Lys levels relative to the National Research Council[4] requirement for 75 to 135 kg pigs (Table 1). Standardized ileal digestible Lys levels ranged from 0.16% to 0.50%. While this approach resulted in minimal changes in feed intake, average daily gain (ADG) decreased up to 71% depending on the SID Lys level fed and duration of feeding. Furthermore, limiting SID Lys decreased protein deposition and increased fat accretion,[5,6,8] which led to decreased carcass lean and increased backfat. Helm et al[7] also observed a decrease in loin muscle area.

Amino acid balance

Reducing the growth of finishing pigs can also be achieved by altering the amino acid pattern of the diet.[12] Helm et al[5] looked at decreasing the isoleucine (Ile):Lys ratio to 0.45% as an approach to decrease feed intake and growth. However, when compared to a standard control diet that contained an Ile:Lys ratio of 0.57%, no statistical differences in growth performance or carcass lean were observed. The lack of response may indicate that a greater reduction in Ile:Lys was needed to affect growth. When evaluating the effect of feeding either 4% methionine (Met), tryptophan (Trp), Lys, or arginine in weanling pig diets, Edmonds et al[13] observed the greatest reduction in growth when feeding excess Met. More recently, excess Met was used in two, 35-day studies, which appears to be the longest feeding period found in the literature for high levels of Met.[9] As Met in the diet increased from 0.1% to 2.0% (0.61% to 4.46% SID sulfur amino acid:Lys), ADG decreased up to 67%, whereas in some cases when Met was increased above 2.0%, pigs began to lose body weight. In contrast, limited effects of excess Met on carcass leanness were observed. Therefore, feeding high levels of Met is effective at reducing growth without causing pigs to become fat. Because pigs adapt to high levels of Met, more Met will need to be added to diets over time to achieve sustained reductions in growth. If producers are interested in long-term strategies, an 80% reduction in SID Lys in combination with a 16% Trp:Lys ratio has been shown to gradually slow the growth of growing-finishing pigs over a 119-day period.[10]

High-fiber diets

Feeding high-fiber diets is another strategy that has been evaluated to reduce finishing pig growth. For this approach to be successful, dietary energy levels need to be decreased as fiber inclusion increases. Thus, pigs will consume more feed to meet their energy requirements until maximum physical capacity for feed intake is reached due to the bulkiness of high-fiber diets. At this point, growth will be reduced because energy requirements have not been met. However, in 2 studies conducted by Helm et al[5,7] feeding 15% neutral detergent fiber (NDF) diets through the addition of soybean hulls had no effect on feed intake or growth regardless of whether pigs were housed individually or in groups. When 20% NDF was fed to group housed pigs, an 11% reduction in average daily feed intake and 19% reduction in ADG was observed, whereas when 20% or 25% NDF was fed to individually housed pigs, only a tendency for reduced growth was observed.[5,7] The discrepancies between the 2 studies are likely a result of different starting body weights or housing systems, as individually housed pigs tend to have increased feed intake compared to group housed pigs because there is no competition around the feeder.[5,7] Regardless of the growth response, a reduction in backfat was observed in both experiments when 20% or 25% NDF was fed. This is likely a result of decreased energy intake because metabolizable energy decreases as NDF levels in the diet increase. While the growth performance responses to fiber are not always consistent and are largely dependent on fiber source, it appears a high dietary fiber level (≥ 20% NDF) is necessary to reduce feed intake and subsequent gain.[5] In contrast, the negative effect of high-fiber diets on carcass yield is more easily replicated and begins to occur at 20% NDF. Increasing fiber in the diet also increases manure volume, therefore, if high-fiber diets are fed for extended periods of time, manure storage may also be affected.

Electrolyte balance

Adjusting the dietary electrolyte balance (dEB) is another approach to supress finishing pig growth. Inclusion of anhydrous calcium chloride ($CaCl_2$) in diets is the most common way for creating an imbalance in dietary electrolytes. Consuming $CaCl_2$ has been shown to increase plasma chloride concentrations which produces metabolic acidosis and leads to decreased feed intake.[14] Despite a supressed appetite, the rate of $CaCl_2$ inclusion and diet formulation method are important to affect growth. The addition of $CaCl_2$ in the diet requires a reduction in calcium from limestone to prevent excess calcium. Although not required, if there is a desire to maintain the calcium:phosphorous ratio when calculated on a standardized total tract digestible phosphorus (Ca:STTD P) or available phosphorous (Ca:aP) basis, monosodium phosphate is one ingredient that can be added to the diet to increase digestible or available phosphorous levels accordingly. In a trial conducted by Helm et al,[7] 4% $CaCl_2$ was added to the diet while maintaining a 2:1 Ca:STTD P through addition of monosodium phosphate to achieve a dEB of -404 mEq/kg. This resulted in a 49% reduction in average daily feed intake and a 77% reduction in ADG. However, no differences were observed when pigs were fed a 2% $CaCl_2$ diet with a dEB of -161 mEq/kg (2:1 Ca:STTD P maintained). These data support earlier reports that recommended feeding a dEB below -250 mEq/kg to elicit reductions in growth.[15] In a separate experiment where 3% $CaCl_2$ (dEB of -282 mEq/kg) was added to the diet but the Ca:aP ratio was not maintained (3.14 control vs 3.26 $CaCl_2$), a 93% reduction in ADG was observed.[5] This suggests that formulation strategy may impact the degree in which growth is slowed. Likewise, increased duration of feeding and heavier starting body weights could also have impacted the response observed. When $CaCl_2$ diets are fed, intake tends to be lowest during the first week of consumption as pigs acclimate to the diet. For carcass characteristics, feeding above 2% $CaCl_2$ resulted in increased carcass lean and decreased backfat as early as 14 days after the beginning of the experimental feeding period. This may reflect lighter body weights at marketing when pigs were fed $CaCl_2$. Furthermore, pigs fed 2% $CaCl_2$ exhibit decreased loin pH and tenderness, which indicates reduced eating quality.[5] Feeding ammonium chloride at 2% or 2.75% of the diet (dEB ≤ -299 mEq/kg) has also been shown to decrease growth by 39% or 98% in 25-kg pigs, respectively.[11] However, when fed at 1.25% with a dEB of -158 mEq/kg, no differences in growth were observed. This response is similar to when 2% $CaCl_2$ was fed, further emphasizing the effect of dEB on pig growth performance.

Table 1: Effect of feeding strategy on the growth and carcass leanness of growing-finishing pigs

Feeding strategy	Housing	Initial BW, kg	Days on feed	Δ ADG*, %	Δ ADFI*, %	Carcass characteristics	Reference
Low protein diets (SID Lys, %)							
0.16	Group	125	42	-47	0†	↓ loin eye area ↓ lean percent ↑ backfat depth	Helm et al, 2021[5]
0.18	Group	89	28	-23	0†	NR	Rao et al, 2021[6]
0.18	Group	89	14	-71	-12	NR	Rao et al, 2021[6]
0.18	Individual	73	28	-59	-19	↓ loin eye area	Helm et al, 2021[7]
0.21	Group	93	42	-55	-4†	↓ lean percent	Norton et al, 2020[8]
0.48	Individual	73	28	-17†	0†	↓ loin eye area	Helm et al, 2021[7]
0.50	Group	89	44	-16	-1†	↓ lean percent ↑ backfat depth	Rao et al, 2021[6]
AA balance							
0.45% Ile:Lys	Group	125	42	-10†	-4†	- †	Helm et al, 2021[5]
2.50% Sulfur AA:Lys	Group	110	35	-28	-15	- †	Edmonds et al, 2021[9]
4.46% Sulfur AA:Lys	Group	110	35	-67	-37	↓ backfat depth	Edmonds et al, 2021[9]
0.16% Trp:Lys‡	Group	32	119	-12	-4†	NR	Russi et al, 2021[10]
High fiber diets (Neutral detergent fiber, %)							
15.0	Group	125	42	+1†	+3†	- †	Helm et al, 2021[5]
15.0	Individual	73	28	+7†	+6†	- †	Helm et al, 2021[7]
20.0	Group	125	42	-19	-11	↓ backfat depth	Helm et al, 2021[5]
20.0	Individual	73	28	-6†	-1†	↓ backfat depth	Helm et al, 2021[7]
25.0	Individual	73	28	-15†	-7†	↓ backfat depth	Helm et al, 2021[7]
dEB, mEq/kg (with $CaCl_2$)							
-161§	Individual	73	28	-15†	-2†	- †	Helm et al, 2021[7]
-282¶	Group	125	42	-93	-42	↓ loin eye area ↑ lean percent ↓ backfat depth	Helm et al, 2021[5]
-404§	Individual	73	28	-77	-49	↓ loin eye area ↓ backfat depth	Helm et al, 2021[7]
dEB, mEq/kg (with NH_4Cl)							
-158¶	Individual	25	21	0	NR	NR	Kokinos et al, 2022[11]
-299¶	Individual	25	21	-39	NR	NR	Kokinos et al, 2022[11]
-439¶	Individual	25	21	-98	NR	NR	Kokinos et al, 2022[11]

* Percent changes in ADG and ADFI were calculated using the control ADG and ADFI for each experiment.

† Not statistically different, $P \geq .05$.

‡ 0.16% SID Trp:Lys was fed in a diet that contained 80% of the SID Lys requirement.

§ Calcium:standardized total tract digestible phosphorus ratio was maintained through the addition of monosodium phosphate in the diet.

¶ When dEB values were not provided, dEB was calculated using the equation dEB, mEq/kg = (Na% × 434.98) + (K% × 255.74) – (Cl% × 282.06). Na, K, and Cl% were determined using National Research Council[4] values for major ingredients.

BW = body weight; ADG = average daily gain; ADFI = average daily feed intake; SID = standardized ileal digestible; Lys = lysine; NR = data not reported; AA = amino acid; Ile = isoleucine; Trp = tryptophan; dEB = dietary electrolyte balance.

Altering the pig's electrolyte balance is a risky approach if water availability is limited. Therefore, care must be taken to ensure pigs have *ad libitum* access to fresh drinking water. Likewise, oversupplying calcium through the inclusion of $CaCl_2$ for an extended period (> 3-4 weeks) may lead to detrimental effects on bone strength.

Management strategies

In addition to nutritional strategies, there are several management opportunities for slowing the growth rate of pigs. The most recommended approaches include increasing barn temperatures through decreased ventilation, increasing stocking density, or decreasing feed access by tightening feeder settings. With each, there are precautionary measures that should be taken to ensure animal and caretaker welfare. A list of recommendations for the different management strategies can be found in several resources that were written during the COVID-19 pandemic.[1-3]

Acknowledgments

This work was supported by contribution No. 23-081-J from the Kansas Agricultural Experimental Station in Manhattan, Kansas.

Conflict of interest

None reported.

Disclaimer

Drs Gebhardt and Tokach, both members of this journal's editorial board, were not involved in the editorial review of or decision to publish this article.

Scientific manuscripts published in the *Journal of Swine Health and Production* are peer reviewed. However, information on medications, feed, and management techniques may be specific to the research or commercial situation presented in the manuscript. It is the responsibility of the reader to use information responsibly and in accordance with the rules and regulations governing research or the practice of veterinary medicine in their country or region.

References

*1. Hostetler C. Feeding strategies to reduce pig growth. National Pork Board. 2020. Accessed February 21, 2023. **https://library.pork.org/media/?mediaId=DD567586-AF07-430D-86E017A0B046AF0A**

2. Tokach MD, Goodband RD, DeRouchey JM, Woodworth JC, Gebhardt JT. Slowing pig growth during COVID-19, models for use in future market fluctuations. *Anim Front.* 2021;11:23-27. **https://doi.org/10.1093/af/vfaa047**

*3. Patience J, Greiner L. Approaches to reducing feed intake and growth rate in market hogs during interruption of animal movement. Published 2020. Accessed February 23, 2022. **https://dr.lib.iastate.edu/bitstreams/8560afe5-6bbd-4360-bd47-32f9bd3502dc/download**

4. National Research Council. Nutrient Requirements Tables. In: *Nutrient Requirements of Swine,* 11th ed. National Academy Press; 2012:228-235.

5. Helm ET, Ross JW, Patience JF, Lonergan SM, Huff-Lonergan E, Greiner LL, Reever LM, Hastad CW, Arkfeld EK, Gabler NK. Nutritional approaches to slow late finishing pig growth: Implications on carcass composition and pork quality. *J Anim Sci.* 2021;99:skaa368. **https://doi.org/10.1093/jas/skaa368**

6. Rao Z-X, Tokach MD, Woodworth JC, DeRouchey JM, Goodband RD, Gebhardt JT. Evaluation of nutritional strategies to slow growth rate then induce compensatory growth in 90-kg finishing pigs. *Transl Anim Sci*. 2021;5:txab037. **https://doi.org/10.1093/tas/txab037**

7. Helm ET, Patience JF, Romoser MR, Johnson CD, Ross JW, Gabler NK. Evaluation of increased fiber, decreased amino acids, or decreased electrolyte balance as dietary approaches to slow finishing pig growth rates. *J Anim Sci*. 2021;99:skab164. **https://doi.org/10.1093/jas/skab164**

*8. Norton S, Betts K, Jolliff J, Pilcher C, Ritter M. A comparison of four diet regimens in late finishing swine designed to slow growth rate. Poster presented at: Allen D. Leman Swine Conference; September 19-22, 2020; Minneapolis, MN.

9. Edmonds MS, Smith II JW. Amino acid imbalance with excess methionine in late-finishing pigs: Effects on performance and carcass quality. *Transl Anim Sci*. 2021;5:txab197. **https://doi.org/10.1093/tas/txab197**

10. Russi AT, Tokach MD, Goodband RD, Gebhardt JT, Woodworth JC, DeRouchey JM, Steck C, Wolfe M. Effects of reducing digestible lysine and tryptophan to lysine ratio on growth performance of grow-finish pigs. *J Anim Sci.* 2021;99(Suppl 1):82-83. **https://doi.org/10.1093/jas/skab054.134**

11. Kokinos B, Grez-Capdeville M, Crenshaw T. Addition of ammonium chloride to feed is an effective strategy to attenuate growth in 25-kg pigs. *J Anim Sci.* 2022;100(Suppl 2):153-154. **https://doi.org/10.1093/jas/skac064.260**

12. Harper AE, Rogers QR. Amino acid imbalance. *Proc Nutr Soc*. 1965;24:173-190. **https://doi.org/10.1079/pns19650032**

13. Edmonds MS, Gonyou HW, Baker DH. Effect of excess levels of methionine, tryptophan, arginine, lysine or threonine on growth and dietary choice in the pig. *J Anim Sci.* 1987;65:179-185. **https://doi.org/10.2527/jas1987.651179x**

14. Yen JT, Pond WG, Prior RL. Calcium chloride as a regulator of feed intake and weight gain in pigs. *J Anim Sci*. 1981;52:778-782. **https://doi.org/10.2527/jas1981.524778x**

*15. Holt JP, Walker P. Regulating feed intake of group housed replacement gilts by altering dietary cation/anion difference. National Pork Board Research Report #10-042. Published July 28, 2011. Accessed May 26, 2022. **https://porkcheckoff.org/wp-content/uploads/2021/02/10-042-WALKER-IllSt-REVISED.pdf**

*Non-refereed references.

Nutritional strategies to improve the growth performance of pigs marketed in summer

Madie R. Wensley, MS; Mike D. Tokach, PhD; Jason C. Woodworth, PhD; Robert D. Goodband, PhD; Joel M. DeRouchey, PhD; Jordan T. Gebhardt, DVM, PhD

Summary

To improve the growth performance of growing-finishing pigs and maximize economic returns for summer marketing, producers can feed increased dietary energy while pigs are still in their energy dependent growth phase. Removal of high-fiber ingredients such as dried distillers' grains with solubles can increase dietary energy and improve gain. During the summer when feed intake is low, formulating diets at or slightly above amino acid requirements may be beneficial. Feed additives that increase growth rate should be considered to improve market weight. Market prices and optimal market weights should drive formulation decisions to maximize income over feed costs.

Keywords: swine, growth performance, growing-finishing pig, summer diets

Received: May 26, 2022
Accepted: December 21, 2022

Resumen - Estrategias nutricionales para mejorar el rendimiento de crecimiento de los cerdos comercializados en verano

Para mejorar el rendimiento de crecimiento de los cerdos en desarrollo y finalización y maximizar los beneficios económicos para la comercialización de verano, los productores pueden aumentar la energía dietética mientras los cerdos aún se encuentran en su fase de crecimiento dependiente de energía. La eliminación de ingredientes ricos en fibra, como los granos secos de destilería con solubles, puede aumentar la energía dietética y mejorar la ganancia. Durante el verano, cuando el consumo de alimento es bajo, puede ser beneficioso formular dietas con, o ligeramente por encima de los requisitos de aminoácidos. Se deben considerar los aditivos para alimento que aumentan la tasa de crecimiento para mejorar el peso a mercado. Los precios de mercado y los pesos de mercado óptimos deben encauzar las decisiones de formulación para maximizar los ingresos sobre los costos de alimentación.

Résumé - Stratégies nutritionnelles pour améliorer les performances de croissance des porcs commercialisés en été

Pour améliorer les performances de croissance des porcs en croissance-engraissement et maximiser les rendements économiques pour la commercialisation estivale, les producteurs peuvent fournir une énergie alimentaire accrue pendant que les porcs sont encore dans leur phase de croissance dépendante de l'énergie. L'élimination des ingrédients riches en fibres tels que les drêches de distillerie séchées avec des solubles peut augmenter l'énergie alimentaire et améliorer le gain. Pendant l'été, lorsque la consommation d'aliments est faible, il peut être bénéfique de formuler des régimes égaux ou légèrement supérieurs aux besoins en acides aminés. Les additifs alimentaires qui augmentent le taux de croissance doivent être envisagés pour améliorer le poids du marché. Les prix du marché et les pondérations optimales du marché devraient guider les décisions de formulation afin de maximiser les revenus par rapport aux coûts d'alimentation.

In the summer months when environmental temperatures increase, a pig's voluntary feed intake (VFI) will typically decrease resulting in reductions in body weight gain.[1] Summer market weights can decrease up to 4.5 kg, which also happens to be at a time when market prices are typically at their yearly high.[2] Furthermore, pigs housed under heat stress conditions exhibit decreased caloric efficiency, reduced carcass lean, and in some cases poorer carcass fat quality compared to pigs housed under cooler ambient temperatures.[3-5] Consequently, there can be significant economic loss associated with decreased market weights. This creates an opportunity to develop feeding programs specifically targeting pigs marketed in North America between May and August to maximize growth performance and economic return. To capture full value, diet formulation changes should begin in February for late nursery or early finishing pigs and continue through July. This provides producers with the maximum opportunity to increase gain leading into summer, whereas late nursery or early finishing pigs placed in July are less of a concern because they will not be marketed until late fall. This practice tip will focus on feeding and management strategies to increase the gain of pigs marketed during the summer months.

Nutritional strategies to maximize growth

Increased energy density

The most common method to improve the growth performance of growing-finishing pigs for summer markets is to increase dietary energy through the

MRW, MDT, JCW, RDG, JMD: Department of Animal Sciences and Industry, Kansas State University, Manhattan, Kansas.

JTG: Department of Diagnostic Medicine/Pathobiology, College of Veterinary Medicine, Kansas State University, Manhattan, Kansas.

Corresponding author: Dr Jordan T. Gebhardt, Department of Diagnostic Medicine/Pathobiology, Kansas State University, Manhattan, Kansas; Email: **jgebhardt@vet.k-state.edu**.

Wensley MR, Tokach MD, Woodworth JC, Goodband RD, DeRouchey JM, Gebhardt JT. Nutritional strategies to improve the growth performance of pigs marketed in summer. *J Swine Health Prod*. 2023;31(4):197-200. **https://doi.org/10.54846/jshap/1321**

inclusion of fat or oil. Typically, adding 1% to 5% fat in diets for growing-finishing pigs will increase gain by approximately 1% for every 1% of added fat.[6] Likewise, feed efficiency is generally improved by approximately 2% for every 1% of added fat.[7] Kellner et al[5] observed that heat stress does not affect the ability of pigs to digest fat, therefore a similar response can be expected under high temperature conditions. When considering fat inclusion in the diet, the response is often greater in growing pigs that have not reached maximum protein deposition. Hence, it may be more economical to feed increased fat levels while pigs are still in their energy dependent phase of growth when capacity for feed intake inhibits maximum gain. This typically occurs in the growing period (up to approximately 80 kg),[8] but also can be later in finishing depending on genetic selection and other environmental, health, or management scenarios. The response to dietary energy is also largely dependent on the lysine:calorie ratio. As energy density of the diet increases, the magnitude of improvement in gain will be limited if dietary lysine is not also increased.[8] When making the decision to increase dietary energy density through fat inclusion, it is important to evaluate income over feed cost (IOFC) to ensure that the value of additional gain is greater than the associated costs to change diet formulation. Alternative byproduct ingredients that have high energy content, such as bakery meal, could be an option to increase the energy density of the diet. However, variability between batches or sources and other intrinsic factors associated with the alternative ingredient must be considered.

Removal of fibrous ingredients

Another way to increase dietary energy would be to reduce or remove the inclusion of high-fiber ingredients such as dried distillers' grains with solubles (DDGS), wheat middlings, or soybean hulls. In contrast to fats, fibrous ingredients have a high heat increment of digestion. Specifically, DDGS have 3 times the level of fiber than corn, which can have a negative effect on feed intake and subsequent growth of pigs.[9] Dried distillers' grains with solubles can also have a negative effect on carcass yield and fat quality. Thus, implementing DDGS withdrawal strategies can be an important component of feeding programs to improve gain and carcass quality. Data by Coble et al[10] suggests that removing DDGS from the diet up to approximately 24 days prior to market can improve hot carcass weights and carcass yield by approximately 1.0% and 1.8%, respectively, with improvements beginning as soon as a 5 days post withdrawal. Withdrawal strategies should allow producers to feed more fibrous diets at a lower cost for an extended amount of time while still capturing carcass gain value to maximize IOFC. As with any feeding strategy, the optimal duration of feeding high-fiber ingredients will depend on the economic situation. Likewise, variation in nutrient values across ingredient sources can have significant impacts on growth performance and economic outcomes. This is particularly important when feeding high levels of DDGS. Hence, analyzing the nutrient composition of the DDGS source will ensure the best economic return.

Increased amino acid levels

Increasing the gain of growing-finishing pigs can potentially be achieved through increasing amino acid (AA) intake if diets are not already formulated for maximal growth. As environmental temperatures increase, pigs typically decrease their VFI resulting in reduced AA intake. Heat stress has also been shown to alter AA metabolism and decrease the efficiency of lysine utilization.[11,12] Thus, if diets are formulated at or marginally below requirements, low VFI could result in AA deficiencies and subsequent reductions in body weight gain, protein deposition, and carcass lean. For this reason, increasing AA concentrations in the diet during the summer may be necessary to improve growth performance.[13] Increasing AA can be achieved through the inclusion of intact protein sources or feed-grade AA. Although, in the summer it may be more beneficial to use feed-grade AA to prevent increases in the heat increment of digestion.[13,14] Successful implementation of this feeding strategy begins with having a clear understanding of the lysine requirements of the genetic source of the pigs being fed and the requirements for maximum growth versus economic return. While targets to maximize IOFC are often lower than the pig's biological requirement for maximal growth performance in the growing and early finishing phase, late finishing maximum economic return is often achieved at a similar level as maximum growth.[15] As the inclusion of DDGS in diets has increased, tryptophan typically becomes the second limiting AA. Research shows that increasing the standardized ileal digestible tryptophan:lysine ratio above National Research Council (NRC) requirements can improve the gain of growing-finishing pigs.[16-18] This implies that feeding pigs at or above their AA requirements is not only important in late finishing, but may be of particular importance for pigs reared in the summer months when feed intake is low.

Phosphorus and copper levels

Ensuring that diets are formulated with adequate levels of standardized total tract digestible phosphorus is another way to potentially improve the gain of growing-finishing pigs (24-130 kg). According to Vier et al,[19] average daily gain (ADG) was maximized (increased by approximately 3%) when feeding 122% of the NRC[16] requirement estimate compared to 100% of the estimate. However, phosphorus levels that achieve maximum growth should be evaluated for economic return to ensure that increased supplementation results in additional revenue above the added cost.[20] Copper from copper sulfate, tribasic copper chloride, or other copper sources may provide additional opportunities to improve the growth performance and hot carcass weights of finishing pigs when provided between 125 and 250 ppm in the diet.[21,22] Data by Coble et al[10] showed that feeding 170 ppm of copper from 25 kg to market resulted in an increase of 3.5 kg in hot carcass weight at processing.

Feed additives

The inclusion of feed additives specifically designed to improve gain is another nutritional strategy that can be implemented. There are several different categories of additives that can be used in diets including growth promoting antibiotics, exogenous enzymes, ionophores, minerals, phytogens, probiotics, and more. When selecting feed additives for pigs marketed in the summer, focus should be on those that improve gain versus those that only improve feed efficiency. For a more complete evaluation on feed additives and their effects on the growth performance of growing-finishing pigs, please refer to the review by Rao et al.[23]

Diet form

Feeding pelleted diets has also been shown to improve the gain of finishing pigs by up to 6.0%.[24,25] During pelleting, the use of heat, steam, and pressure increases starch gelatinization and protein

denaturation, therefore increasing the energy and protein digestibility of cereal grains.[26] Despite these benefits, feeding pellets for an extended period (ie, ≥ 58 days) can increase the incidence of ulcers, thereby increasing herd removal rates.[27] Either rotating between pelleted and meal diets or feeding pelleted diets for a shorter time duration (ie, in late finishing) can help ameliorate these challenges.

Management strategies to maximize growth

In addition to nutritional strategies, there are several management opportunities for pigs marketed in the summer. These strategies should focus on increasing days in the barn or improving gain by leveraging available space. Increasing days in the barn is often the most economical option to increase market weight; however, this may not be feasible because of facility constraints or the need to meet packer marketing contracts. If this is an option, the decision will need to be made early about how to successfully manage pig flow to increase days. For example, double stocking nursery or wean-to-finish barns that are placed in early to mid-summer and leaving them double stocked for slightly longer will allow pigs downstream extra days on feed. If this approach is not an option, stocking density and marketing strategies can be opportunities to optimize the utilization of space. Hence, moving into summer when gain is most valuable, stocking finishing pigs with more square footage is an option to improve gain and carcass quality,[4] whereas pigs marketed in winter can be stocked with less square footage. White et al[4] showed that increasing the space allowance of growing-finishing pigs from 0.66 m^2 to 0.93 m^2 under high temperature (32.2°C) conditions, increased ADG by 27%.

Marketing strategies should also be evaluated to ensure that pigs are removed from pens when space begins to limit growth to prevent prolonged reductions in ADG.[28] However, it is also important to keep in mind that marketing or topping barns too early, particularly when pigs are growing slower, can have negative implications on IOFC if pigs are marketed lighter than optimal. Other management strategies that should be part of daily animal care include, making sure feeder adjustments are not too tight, barn temperatures and ventilation setpoints are in line with pig needs, and that cooling systems (ie, sprinklers and extra air movement) are being used when available.

Economic considerations

Increasing nutrient density or including dietary feed additives comes with increased cost. Therefore, evaluating diet formulation strategies to improve the growth of pigs marketed in the summer needs to begin with having a clear understanding of seasonal growth and market trends. Knowing the pig flow, genetics, and optimal market weights based on packer grids of the production system is key. This information will help make informed decisions based on the inputs and outputs of different nutritional or management strategies to maximize IOFC. This is not only important for summer marketing but is necessary year-round to develop successful growing-finishing pig feeding programs. Examples of economic calculations in swine nutrition can be found in the Kansas State University Swine Nutrition Guide.[29]

Acknowledgments

This work was supported by contribution No. 23-082-J from the Kansas Agricultural Experimental Station in Manhattan, Kansas.

Conflict of interest

None reported.

Disclaimer

Drs Gebhardt and Tokach, both members of this journal's editorial board, were not involved in the editorial review of or decision to publish this article.

Scientific manuscripts published in the *Journal of Swine Health and Production* are peer reviewed. However, information on medications, feed, and management techniques may be specific to the research or commercial situation presented in the manuscript. It is the responsibility of the reader to use information responsibly and in accordance with the rules and regulations governing research or the practice of veterinary medicine in their country or region.

References

1. Renaudeau D, Gourdine JL, and St-Pierre NR. A meta-analysis of the effects of high ambient temperature on growth performance of growing-finishing pigs. *J Anim Sci*. 2011;89:2220-2230. **https://doi.org/10.2527/jas.2010-3329**

*2. United States Department of Agriculture Animal and Plant Health Inspection Service. National daily hog and pork summary. 2022. Accessed April 6, 2022. **https://www.ams.usda.gov/mnreports/lsddhps.pdf**

3. Brown-Brandl TM, Nienaber JA, Turner LW, Yen JT. Manual and thermal induced feed intake restriction on finishing barrows. I: Effects on growth, carcass, composition, and feeding behavior. *Trans ASAE*. 2000;43:987-992. **https://doi.org/10.13031/2013.2996**

4. White HM, Richert BT, Schinckel AP, Burgess JR, Donkin SS, Latour MA. Effects of temperature stress on growth performance and bacon quality in grow-finish pigs housed at two densities. *J Anim Sci.* 2008;86:1789-1798. **https://doi.org/10.2527/jas.2007-0801**

5. Kellner TA, Baumgard LH, Prusa KJ, Gabler NK, Patience JF. Does heat stress alter the pig's response to dietary fat? *J Anim Sci.* 2016;94:4688-4703. **https://doi.org/10.2527/jas.2016-0756**

*6. Menegat MB, Goodband RD, DeRouchey JM, Tokach MD, Woodworth JC, Dritz SS. Energy sources for swine diets: fats and oils. Kansas State University Swine Nutrition Guide. Published 2019. Accessed April 11, 2022. **https://www.asi.k-state.edu/extension/swine/swinenutritionguide/pdf/KSU%20Energy%20Sources%20for%20Swine%20Diets%20-%20Fats%20fact%20sheet.pdf**

*7. Van Heugten E. Growing-finishing swine nutrition recommendations and feeding management. Pork Information Gateway. PIG 07-01-09. Published March 25, 2010. Accessed April 6, 2022. **https://porkgateway.org/resource/growing-finishing-swine-nutrient-recommendations-and-feeding-management**

8. Nitikanchana S, Dritz SS, Tokach MD, DeRouchey JM, Goodband RD, White BJ. Regression analysis to predict growth performance from dietary net energy in growing-finishing pigs. *J Anim Sci*. 2015;93:2826-2839. **https://doi.org/10.2527/jas.2015-9005**

9. Stein HH, Shurson GC. The use and application of distillers dried grains with solubles in swine diets. *J Anim Sci.* 2009;87:1292-1303. **https://doi.org/10.2527/jas.2008-1290**

10. Coble KF, DeRouchey JM, Tokach MD, Dritz SS, Goodband RD, Woodworth JC. Effects of withdrawing high-fiber ingredients before marketing on finishing pig growth performance, carcass characteristics, and intestinal weights. *J Anim Sci*. 2018;96:168-180. **https://doi.org/10.1093/jas/skx048**

11. Lopez J, Goodband RD, Alee GL, Jesse GW, Nelssen JL, Tokach MD, Spiers D, Becker BA. The effects of diets formulated on an ideal protein basis on growth performance, carcass characteristics, and thermal balance of finishing gilts housed in a hot, diurnal environment. *J Anim Sci*. 1994;72:367-379. **https://doi.org/10.2527/1994.722367x**

12. Morales A, Cota SEM, Ibarra NO, Arce N, Htoo JK, Cervantes M. Effect of heat stress on the serum concentrations of free amino acids and some of their metabolites in growing pigs. *J Anim Sci*. 2016;94:2835-2842. **https://doi.org/10.2527/jas.2015-0073**

13. Morales A, Chávez M, Vásquez N, Htoo JK, Buenabad L, Espinoza S, Cervantes M. Increased dietary protein or free amino acids supply for heat stress pigs: Effect on performance and carcass traits. *J Anim Sci*. 2018;96:1419-1429. **https://doi.org/10.1093/jas/sky044**

14. Kerr BJ, Yen JT, Nienaber JA, Easter RA. Influence of dietary protein level, amino acid supplementation and environmental temperature on performance, body composition, organ weights and total heat production of growing pigs. *J Anim Sci*. 2003;81:1998-2007. **https://doi.org/10.2527/2003.8181998x**

15. Royall R. *Determining growing-finishing pig lysine requirements and the effects of potassium bicarbonate and crystalline lysine level on finishing pig performance*. Thesis. Kansas State University; 2022.

16. National Research Council. Nutrient Requirements Tables. In: *Nutrient Requirements of Swine*, 11th ed. National Academy Press; 2012:228-235.

17. Salyer JA, Tokach MD, DeRouchey JM, Dritz SS, Goodband RD, Nelssen JL. Effects of standardized ileal digestible tryptophan:lysine in diets containing 30% dried distillers grains with solubles on finishing pig performance and carcass traits. *J Anim Sci*. 2013;91:3244-3252. **https://doi.org/10.2527/jas.2012-5502**

18. Gonçalves MAD, Tokach MD, Bello NM, Touchette KJ, Goodband RD, DeRouchey JM, Woodworth JC, Dritz SS. Dose-response evaluation of the standardized ileal digestible tryptophan:lysine ratio to maximize growth performance of growing-finishing gilts under commercial conditions. *Animal*. 2018;12:1380-1387. **https://doi.org/10.1017/S1751731117002968**

19. Vier CM, Dritz SS, Fangzhou W, Tokach MD, DeRouchey JM, Goodband RD, Gonçalves MAD, Orlando UAD, Chitakasempornkul K, Woodworth JC. Standardized total tract digestible phosphorus requirement for 24- to 130-kg pigs. *J Anim Sci.* 2019;97:4023-4031. **https://doi.org/10.1093/jas/skz256**

*20. Vier CM, Dritz SS, Tokach MD, Orlando UAD, Cast W, Woodworth, JC, Goodband RD, DeRouchey JM. Economic model for optimum standardized total tract digestible phosphorus for finishing pigs. Kansas Agricultural Experiment Station Research Reports: 2019;5. **https://doi.org/10.4148/2378-5977.7861**

21. Davis ME, Maxwell CV, Brown DC, de Rodas BZ, Johnson ZB, Kegley EB, Hellwig DH, Dvorak RA. Effect of dietary mannan oligosaccharides and(or) pharmacological additions of copper sulfate on growth performance and immunocompetence of weanling and growing/finishing pigs. *J Anim Sci.* 2002;80:2887-2894. **https://doi.org/10.2527/2002.80112887x**

22. Coble KF, DeRouchey JM, Tokach MD, Dritz SS, Goodband RD, Woodworth JC, Usry JL. The effects of copper source and concentration on growth performance, carcass characteristics, and pen cleanliness in finishing pigs. *J Anim Sci.* 2017;95:4052-4059. **https://doi.org/10.2527/jas.2017.1624**

23. Rao Z-X, Tokach MD, Woodworth JC, DeRouchey JM, Goodband RD, Gebhardt JT. Effects of various feed additives on finishing pig growth performance and carcass characteristics: A review. *Animals*. 2023;13:200. **https://doi.org/10.3390/ani13020200**

24. Nemechek JE, Tokach MD, Dritz SS, Goodband RD, DeRouchey JM, Woodworth JC. Effects of diet form and type on growth performance, carcass yield, and iodine value of finishing pigs. *J Anim Sci*. 2015;93:4486-4499. **https://doi.org/10.2527/jas.2015-9149**

*25. Potter ML, Tokach MD, DeRouchey JM, Goodband RD, Nelssen JL, Dritz SS. Effects of meal or pellet diet form on finishing pig performance and carcass characteristics. In: *Proceedings of KSU Swine Day*. Kansas State University Agricultural Experiment Station and Cooperative Extension Service; 2009:245-251. **https://doi.org/10.4148/2378-5977.6789**

26. Rojas OJ, Stein HH. Effects of reducing the particle size of corn grain on the concentration of digestible and metabolizable energy and on the digestibility of energy and nutrients in corn grain fed to growing pigs. *Livest Sci*. 2015;181:187-193. **https://doi.org/10.1016/j.livsci.2015.09.013**

27. De Jong JA, Derouchey JM, Tokach MD, Dritz SS, Goodband RD, Woodworth JC, Allerson MW. Evaluating pellet and meal feeding regimes on finishing pig performance, stomach morphology, and carcass characteristics. *J Anim Sci.* 2016;94:4781-4788. **https://doi.org/10.2527/jas.2016-0461**

28. Flohr JR, Tokach MD, DeRouchey JM, Woodworth JC, Goodband RD, Dritz SS. Evaluating the removal of pigs from a group and subsequent floor space allowance on the growth performance of heavy–weight finishing pigs. *J Anim Sci*. 2016;94:4388-4400. **https://doi.org/10.2527/jas.2016-0407**

*29. Menegat MB, Goodband RD, DeRouchey JM, Tokach MD, Woodworth JC, Dritz SS. Economics in swine nutrition. Kansas State University Swine Nutrition Guide. Published 2019. Accessed April 11, 2022. **https://www.asi.k-state.edu/extension/swine/swinenutritionguide/pdf/KSU%20Economics%20in%20Swine%20Nutrition%20fact%20sheet.pdf**

*Non-refereed references.

Conversion tables

Weights and measures conversions

Common (US)	Metric	To convert	Multiply by
1 oz	28.35 g	oz to g	28.35
1 lb (16 oz)	0.45 kg	lb to kg	0.45
2.2 lb	1 kg	kg to lb	2.2
1 in	2.54 cm	in to cm	2.54
0.39 in	1 cm	cm to in	0.39
1 ft (12 in)	0.3 m	ft to m	0.3
3.28 ft	1 m	m to ft	3.28
1 mi	1.6 km	mi to km	1.6
0.62 mi	1 km	km to mi	0.62
1 in^2	6.45 cm^2	in^2 to cm^2	6.45
0.16 in^2	1 cm^2	cm^2 to in^2	0.16
1 ft^2	0.09 m^2	ft^2 to m^2	0.09
10.76 ft^2	1 m^2	m^2 to ft^2	10.8
1 ft^3	0.03 m^3	ft^3 to m^3	0.03
35.3 ft^3	1 m^3	m^3 to ft^3	35.3
1 gal (128 fl oz)	3.8 L	gal to L	3.8
0.26 gal	1 L	L to gal	0.26
1 qt (32 fl oz)	0.95 L	qt to L	0.95
1.06 qt	1 L	L to qt	1.06

Temperature equivalents (approx)

°F	°C
32	0
50	10.0
60	15.5
61	16.1
65	18.3
70	21.1
75	23.8
80	26.6
82	27.7
85	29.4
90	32.2
102	38.8
103	39.4
104	40.0
105	40.5
106	41.1
212	100.0

°F = (°C × 9/5) + 32
°C = (°F - 32) × 5/9

Conversion chart, kg to lb (approx)

Pig size	Lb	Kg
Birth	3.3-4.4	1.5-2.0
Weaning	7.7	3.5
	11	5
	22	10
Nursery	33	15
	44	20
	55	25
	66	30
Grower	99	45
	110	50
	132	60
Finisher	198	90
	220	100
	231	105
	242	110
	253	115
Sow	300	136
	661	300
Boar	794	360
	800	363

Conversion calculator available at: amamanualofstyle.com/page/si-conversion-calculator

1 tonne = 1000 kg
1 ppm = 0.0001% = 1 mg/kg = 1 g/tonne
1 ppm = 1 mg/L


USDA Animal and Plant Health Inspection Service
U.S. DEPARTMENT OF AGRICULTURE
AFRICAN SWINE FEVER
PREVENTION IS THE ONLY CURE.
PROTECT OUR PIGS
FIGHT AFRICAN SWINE FEVER
A single case of African swine fever could wipe out America's swine population. Help farmers defend their herds by sharing vital information on biosecurity safeguards, signs of infection and reporting protocols. Get materials to spread the word – and stop the virus.
www.aphis.usda.gov/ProtectOurPigs
The U.S. Department of Agriculture is an equal opportunity provider, employer, and lender.

Prepare for a foreign animal disease outbreak one step at a time

In 2018, the global pork industry was shaken with the spread of African swine fever (ASF). In 2019, there was growing concern over response and recovery, with more resources focused on how to prevent and prepare for a domestic outbreak. In 2020, the industry faced additional challenges with the COVID-19 pandemic, and US producers unfortunately had to make tough decisions regarding depopulation and disposal. These events led to resource scarcity and challenged producers' abilities to be prepared for an animal health emergency. In response to these challenges, research and collaboration led to on-farm solutions.

In 2022, Checkoff funds were invested to elevate disease response preparedness with exercises led by the National Pork Board in partnership with state pork associations, regional and state veterinary officials, swine veterinarians, producers, disposal subject matter experts, and academia. These fully functional exercises simulated a real-world response to a foreign animal disease (FAD) outbreak.

"Nobody wants to experience an FAD and potentially depopulate their farms. But, in situations where it may be necessary, all farmers should be as prepared as possible to manage their animals, their employees, and their families the best they can," said Dr Lisa Becton, director of swine health for the National Pork Board. "The exercises are important to review a preparedness plan and develop a checklist of needs — including mental and physical resources — so decisions are carefully made in the midst of a crisis."

The exercises focused on:

- Practicing an FAD investigation on a pig farm.
- Exploring active use of AgView traceability in FAD and epidemiological investigations.
- Increasing stakeholder understanding of FAD response and building producer confidence in a state's FAD investigation, depopulation, and disposal activities.

Tools work together – but veterinarian voices are needed

The 4-day exercises combined science and action, using Checkoff-funded tools like AgView, Certified Swine Sample Collector Training Program, Secure Pork Supply, and the US Swine Health Improvement Plan, intertwined with research for a consolidated response.

"Veterinarians are key in an FAD outbreak because they have training and knowledge of disease transmission and containment. The US Department of Agriculture uses established guidance, including the *African Swine Fever Response Plan: The Red Book*, to manage the response efforts during an outbreak. Veterinarians are a trusted resource for producers and are a liaison working with state and federal partners for managing an outbreak," Dr Becton continued.

Tools producers should use, and veterinarians should know

AgView - A contact-tracing platform for swine to provide real-time analysis to state animal health officials (SAHOs) to regionalize the spread of an outbreak. During the exercises, SAHOs reviewed the quarantine notice, set boundaries for the 72-hour hold, and used AgView for determining epidemiology of the outbreak, conducting tracebacks, and tracking animal movements.

Secure Pork Supply - A unified, farm-specific business continuity plan for sites under movement restrictions but not infected with ASF.

Certified Swine Sample Collector training program – Category II Accredited veterinarians train producers, caretakers, and industry partners on how to properly collect samples for diagnostic and surveillance purposes. During an outbreak, biosecurity will challenge the movement of veterinarians, thus creating the need for additional, trained workforce to collect the large number of samples required.

US Swine Health Improvement Plan - A certification aiming to mitigate disease introduction risks and provide a practical means for demonstrating evidence of freedom of disease outside FAD control areas in support of ongoing interstate commerce and a pathway towards the resumption of international trade.

Lessons learned inform future needs

These exercises helped identify important details of preparedness and response without having the accompanying stress of an animal health challenge.

"The key lessons learned include understanding no two sites or states are the same and expect the unexpected," said Dr Becton. "These are functional exercises to help SAHOs and producers develop a sound plan. This plan is also useful for managing endemic diseases."

Through these exercises, key knowledge gaps were identified, which led to the following research needs:

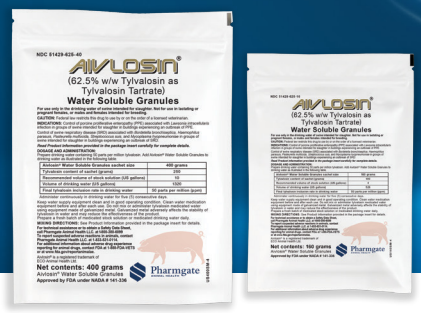
- Understanding ASF virus survivability for different disposal methods;
- Evaluating feed biosecurity;
- Determining effective on-farm, post-outbreak clean-up strategies, including managing scavengers; and
- Investigating diagnostic sample types for rapid ASF detection.

Due to the successful learnings from the 2022 exercises, there are plans to continue fully functional and tabletop exercises in 2023 to practice FAD response in commercial production sites, show pigs, and cull animal markets.

Creating a comprehensive FAD preparedness plan can be daunting – but taking it one step at a time makes it less overwhelming. Industry-led research, stakeholder and veterinarian expertise, planning tools, and functional exercises collectively fill knowledge gaps to help successfully tackle animal health challenges.

HERD HEALTH

YOUR PROTOCOL. OUR PORTFOLIO.



When ileitis breaks, STRIKE BACK.

Aivlosin® works rapidly[1] to control ileitis. With a zero day withdrawal Aivlosin® Water Soluble Granules easily fits into your herd health protocols.

AIVLOSIN®

(62.5% w/w Tylvalosin as Tylvalosin Tartrate)

Water Soluble Granules

Scan the code for label indications.

Pharmgate ANIMAL HEALTH

Ask your vet about Aivlosin® or visit **pharmgate.com**

Important Safety Information: Available under prescription only. AIVLOSIN is indicated for control of porcine proliferative enteropathy (PPE) associated with *Lawsonia intracellularis* infection in groups of swine intended for slaughter in buildings experiencing an outbreak of PPE. Control of swine respiratory disease (SRD) associated with *Bordetella bronchiseptica, Haemophilus parasuis, Pasteurella multocida, Streptococcus suis*, and *Mycoplasma hyopneumoniae* in groups of swine intended for slaughter in buildings experiencing an outbreak of SRD. For use only in drinking water of pigs. Not for use in lactating or pregnant females, or males and females intended for breeding. People with known hypersensitivity to tylvalosin tartrate should avoid contact with this product. When used in accordance with label directions, no withdrawal period is required before slaughter for human consumption.

[1] Stuart et al. Intra-cellular accumulation and trans-epithelial transport of Aivlosin, tylosin and tilmicosin. Pig J 2007; 60: 26-35.

Call for abstracts - Research Topics

Plans are underway for the 55th Annual Meeting of the American Association of Swine Veterinarians to take place February 24-27, 2024, in Nashville, Tennessee.

As part of the meeting, there will be a session highlighting research projects related to swine health and production (virology, bacteriology, parasitology, environment, food safety, odor, welfare, etc). Abstracts are now being accepted for consideration for presentation during the Research Topics session, which will be held Sunday, February 25.

Those interested in making a 15-minute oral presentation of **previously unpublished**, applied research must submit 2 copies of a one-sided, one-page abstract. One copy should contain the abstract title but must omit the authors' names and affiliations for review purposes. Use 1-inch margins and 12-point Times New Roman font. Tables and figures may be included but must fit on the page with the text. The submitted abstracts will be used for review purposes only.

Submit abstracts to **aasv@aasv.org** no later than **August 15, 2023**. Provide the **presenting author's** name, mailing address, phone number, and email address within the email message accompanying each submission.

Abstracts not selected for oral presentation will be considered for poster presentation. All submitting authors will be notified of the selection results in September. Authors of abstracts selected for oral or poster presentation must provide a paper formatted for publication in the conference proceedings by November 15, 2023.

PLEASE NOTE: Participation in the Research Topics oral and poster session is at the presenter's expense. No speaking stipend or travel expense reimbursement is paid by the AASV. **The presenting author is required to register for and attend the meeting in person to make the presentation**. **Recorded or virtual presentations will not be accepted unless the meeting converts to an entirely virtual event.**

It is not necessary to be an AASV member to submit an abstract for consideration or participate if selected. Nonmember participants may register for the meeting at the AASV regular member rate. Qualifying full-time graduate students must join AASV if they wish to register at the graduate student member rate.

Call for submissions – Industrial Partners

The American Association of Swine Veterinarians invites submissions for the Industrial Partners oral and poster sessions at the 55th AASV Annual Meeting. This is an opportunity for commercial companies to make brief presentations of a technical, educational nature to members of the AASV. The conference will be held February 24-27, 2024, in Nashville, Tennessee.

The oral sessions consist of a series of 15-minute presentations scheduled from 1:00 to 5:00 PM on Sunday afternoon, February 25. A poster session takes place the same day. Poster authors will be required to be stationed with their poster from noon until 1:00 PM, and the posters will remain on display throughout the afternoon and the following day for viewing.

SUBMISSION PREREQUISITE: All companies submitting topics for presentation during the Industrial Partners sessions must register to participate in the AASV Technical Tables Exhibit before September 29.

SUBMISSION LIMIT: Restricted program space necessitates a limit on the number of presentations per company. Companies that are a member of the *Journal of Swine Health & Production* (JSHAP) Industry Support Council **and** sponsor the AASV e-Letter may submit 3 topics for oral presentation. Companies that are **either** a member of the JSHAP Industry Support Council **or** sponsor the AASV e-Letter may submit up to 2 topics. All other companies may submit 1 topic for oral presentation. In addition, every company may submit 1 topic for poster presentation, but the topic must not duplicate the oral presentation. All topics must represent information not previously presented at the AASV Annual Meeting or published in the meeting proceedings.

To participate, send the following information to aasv@aasv.org by September 29, 2023:

1) Company name
2) Presentation title
3) Brief description of the presentation content
4) Presenter name (one only) and contact details (mailing address, telephone number, and e-mail address)
5) Whether the submission is intended for oral or poster presentation

Receipt of submissions will be confirmed by email. Presenters will be notified of their acceptance by October 16 and must submit a paper by November 15 for publication in the meeting proceedings. Failure to submit the paper in a timely manner will jeopardize the company's future participation in these sessions.

The presenting author is required to register for and attend the meeting in-person to make the presentation. Recorded or virtual presentations will not be accepted unless the meeting converts to an entirely virtual event.

Presenters may register for the meeting either as a Tech Table representative or as an individual registrant (nonmember oral and poster presenters are eligible to register at the AASV regular member rate). The AASV does not provide a speaking stipend or travel reimbursement to Industrial Partners presenters.

AASV news continued on page 207


uniferon®
Iron(III) Dextran
us.uniferon.com
THE NEW RESEARCH ABOUT TWO DOSES OF UNIFERON® FOR BABY PIGS IS SO GOOD, WE PAID FOR THIS AD JUST TO TELL YOU WE CAN'T TALK ABOUT IT YET.
But don't worry. We'll be buying another ad soon.
PHARMACOSMOS
Uniferon® is a registered trademark of Pharmacosmos A/S. All rights reserved. Pharmacosmos, Inc. is a wholly-owned U.S. subsidiary of Pharmacosmos A/S
PM-067-00

AASV news continued from page 205

AASV Board of Directors, committee leaders meet

The AASV Board of Directors met with committee leaders on April 26, 2023, in Des Moines, Iowa. Committee leaders described committee activities and projects and presented requests to the directors.

The AASV Board of Directors met the following day to conduct official business. The board took several actions during the business section of their meeting which included:

MANRRS conference - At the request of the Diversity, Equity, and Inclusion Committee, the board approved deferring to 2024 the previously approved funding of up to $5000 for exhibit, registration, and travel for 2 AASV members to participate in the Minorities in Agriculture, Natural Resources, and Related Sciences (MANRRS) conference.

Member demographics - The board voted to begin collecting demographic information, including gender, race, ethnicity, and birth year, during annual dues renewal. Any sharing of demographic information will require Executive Committee approval.

Swine veterinarian attrition survey - Acting upon a request from the Early Career Committee, the board approved spending up to $8000 to hire the ISU Center for Survey Statistics & Methodology-Survey Research Services to conduct 8 to 25 exit interviews of former swine veterinarians to provide insight on reasons and circumstances surrounding early-career swine veterinarian attrition.

Hearing screening - The board approved a motion from the Human Health, Safety, and Well-being Committee to provide hearing screening to AASV members at the 2024 AASV Annual Meeting at no cost to the association or its members. Additionally, the board voted to provide a complimentary Tech Table and one registration for a representative from AgriSafe to participate in the 2024 AASV Annual Meeting.

Whole genome sequencing fact sheets - The board granted the PRRS Task Force's request for $4500 to prepare 2 fact sheets on whole genome sequencing.

Swine Medicine Talks - The board approved the Student Engagement Committee's motion for $2500 to fund the Swine Medicine Talks in 2023-24.

Student delegate expenses - The board approved a motion that AASV reimburse travel and lodging expenses for the AASV Student Delegate and Alternate Student Delegate to attend the AASV Annual Meeting.

Swine medicine education manuscript - The board voted to approve the Collegiate Activities Committee's manuscript for publication in JAVMA, and to fund the $1200 fee to provide open access to the published manuscript. The manuscript reports the results of the committee's survey on swine medicine education.

International withdrawal database - The board passed a motion to endorse and support creation and maintenance of a swine-specific international withdrawal database to protect pork access to major export markets through evidence-based withdrawal intervals for commonly used drugs. To include (but not limited to) administration of funds, organization of advisory board, and potential financial investment upon board approval.

Standardized outbreak investigation instrument - The board approved a motion from the PRRS Task Force to endorse a standardized outbreak investigation instrument.

Committee mission and name changes

PRRS Task Force name and mission change - The board passed a motion to change the PRRS Task Force to the PRRS Committee and approved a revised mission statement, available at **aasv.org/members/only/committee/PRRSCommittee.php.**

Boar Stud Committee mission change - The board approved revising the committee's mission statement to include mention of boar welfare and human safety. See **aasv.org/members/only/committee/BoarStud.php.**

Position Statements

AASV position statements undergo review every 3 years on a rotating basis. See **aasv.org/aasv/positions** for all current positions.

Stop Movement Situations - The board voted to sunset the AASV positions on Pig Welfare During Stop Movement Situations and Strategies for Responding to Processing Disruption Due to the COVID-19 Pandemic, and replace them with the combined statement, Stop Movement Situations.

Federal Funding for Swine Disease Research - The board reaffirmed this position.

Premises Registration - The board reaffirmed this position. It is expected that the Transboundary and Emerging Diseases Committee will proceed with plans to prepare a new statement on comprehensive traceability.

Maximum Residue Limits - The board approved the Pharmaceutical Committee's motion to revise the previous position on maximum residue limits to AASV Recommendations to Meet Requirements and Prevent Violative Residues in US Pork and Pork Products**.**

Telemedicine - The board approved a new position on Telemedicine.

AASV members can read complete AASV Board of Directors and Executive Committee meeting minutes at **aasv.org/aasv/board.**

Interested in joining a committee? Contact the AASV office by email, **aasv@aasv.org**, or phone, 515-465-5255.

AASV news continued on page 209

CIRCUMVENT® CML

One Revolutionary 3-in-1 Vaccine

Circumvent® C-M-L

Protect pigs from porcine circovirus types 2a and 2d, *Mycoplasma hyopneumoniae* and *Lawsonia intracellularis* with CIRCUMVENT CML – the first and only vaccine that covers these three major causes of disease with just one injection.

+ **FEWER INJECTIONS**
+ **FEWER BOTTLES TO MANAGE**
+ **MORE COMFORT**
+ **MORE CONVENIENCE**

For a singularly better experience for your staff and your animals,

SWITCH TO CIRCUMVENT CML.

DrivenByPrevention.com • 800-521-5767

DRIVEN BY PREVENTION®

MERCK Animal Health

AASV news continued from page 207

Call for papers – AASV 2024 Student Seminar and veterinary student scholarships

The American Association of Swine Veterinarians announces an opportunity for veterinary students to make a scientific presentation at the AASV Annual Meeting in Nashville, Tennessee on Sunday, February 25, 2024. Interested students are invited to submit a one-page abstract of a research paper, clinical case study, or literature review for consideration. The submitting student must be a current (2023-24) student member of the AASV at the time of submission and must not have graduated from veterinary school prior to February 25, 2024. Submissions are limited to 1 abstract per student.

Abstracts and supporting information must be submitted online at **cmt3.research.microsoft.com/AASV2024**. Submissions must be completed before **11:59 PM Central Daylight Time** on **Wednesday, September 13, 2023** (firm deadline). Late submissions will not be considered.

Students will receive an email confirmation of their submission. If they do not receive the confirmation email, they must contact Dr Andrew Bowman (**bowman.214@osu.edu**) by Friday, September 15, 2023 with supporting evidence that the submission was made in time; otherwise the abstract will not be considered for judging.

The abstracts will be reviewed by an unbiased, professional panel consisting of private practitioners, academicians, and industry veterinarians. Fifteen abstracts will be selected for oral presentation in the Student Seminar at the AASV Annual Meeting. Students will be notified of the review results by October 16, 2023, and those selected to participate will be expected to provide the complete paper or abstract, reformatted for publication in the conference proceedings, by November 15, 2023.

Student Seminar

Student participants will receive presentation awards and compete for scholarships awarded through the AASV Foundation. The oral presentations will be judged to determine the scholarship amount. The **Zoetis Foundation** has provided a $26,250 grant to the AASV Foundation to support awards and the top student presenter scholarship. This includes a $750 award for the student presenter of each paper selected for oral presentation at the meeting. Through the Zoetis Foundation's grant, the AASV Foundation will also award a $5,000 scholarship to the student whose project and oral presentation are judged best overall.

Elanco Animal Health provides $20,000 in additional funding, enabling the AASV Foundation to award scholarships of $2500 each for 2nd through 5th place, $1500 each for 6th through 10th place, and $500 each for 11th through 15th place.

Student Poster Session

Abstracts that are not selected for oral presentation in the Student Seminar will be considered for presentation in a poster session at the Annual Meeting. Those who participate in the poster session will receive a $500 presentation stipend funded by the AASV Foundation through a grant from the **Zoetis Foundation** and additional support from AASV. All students selected to make a poster presentation will be expected to supply a brief paper, formatted for publication in the conference proceedings, by November 15. The guidelines for preparing posters for the display are available at **aasv.org/annmtg/2024/posters.php**.

Veterinary Student Poster Competition

The presenters of the top 15 poster abstracts compete for scholarship awards ranging from $200 to $500 in the Veterinary Student Poster Competition, sponsored by **United Animal Health**. See **aasv.org/annmtg/2024/postercomp** for poster judging details.

In all cases, the student presenter is **required to attend the meeting in person to make the presentation.** Recorded or virtual presentations will not be accepted unless the meeting converts to an entirely virtual event.

Complete information for preparing and submitting abstracts is available at **aasv.org/annmtg/2024/studentseminar**. The rules for submission should be followed carefully. For more information, contact the AASV office by phone, 515-465-5255, or email, **aasv@aasv.org**.

AASV news continued on page 211

WORKS FAST TO DELIVER BROAD PROTECTION FOR PIGS

Tenotryl™ (enrofloxacin) injectable solution

Tenotryl™ (enrofloxacin) injectable solution works quickly against the primary pathogens that cause swine respiratory disease (SRD) and associated with *Escherichia coli*. Enrofloxacin, the active ingredient, is an efficient, broad-spectrum antibiotic that has been trusted in the U.S. swine industry for 25 years.

Tenotryl™ (enrofloxacin) injectable solution is indicated for the treatment and control of swine respiratory disease (SRD) associated with *Actinobacillus pleuropneumoniae, Pasteurella multocida, Haemophilus parasuis, Streptococcus suis, Bordetella bronchiseptica* and *Mycoplasma hyopneumoniae*. It is also indicated for the control of colibacillosis in groups or pens of weaned pigs where colibacillosis associated with *E. coli* has been diagnosed.

For swine, Tenotryl™ is marketed in the U.S. by Pharmgate Animal Health. Talk to your Pharmgate representative or visit **pharmgate.com/tenotryl.**

SWINE IMPORTANT SAFETY INFORMATION

Tenotryl™ (enrofloxacin) 100 mg/ml Antimicrobial Injectable Solution: Not for use in humans. For intramuscular or subcutaneous use in swine. Federal (USA) law restricts this drug to use by or on the order of a licensed veterinarian and prohibits the extra-label use of this drug in food producing animals. To assure responsible antimicrobial drug use, enrofloxacin should only be used as a second-line drug for colibacillosis in swine following consideration of other therapeutic options. Animals intended for human consumption must not be slaughtered within 5 days of receiving a single injection dose. The effects of enrofloxacin on swine reproductive performance, pregnancy and lactation have not been adequately determined. The long-term effects on articular joint cartilage have not been determined in pigs above market weight. Subcutaneous or intramuscular injection in swine can cause a transient local tissue reaction and may result in trim loss of edible tissue at slaughter. Quinolone-class drugs should be used with caution in animals with known or suspected Central Nervous System (CNS) disorders.

Virbac

Shaping the future of animal health

Brief Summary of Prescribing Info for Swine

Tenotryl™ (enrofloxacin) 100 mg/mL Antimicrobial Injectable Solution

For Intramuscular Or Subcutaneous Use In Swine

CAUTION:
Federal (USA) law restricts this drug to use by or on the order of a licensed veterinarian. Federal (USA) law prohibits the extra-label use of this drug in food-producing animals. To assure responsible antimicrobial drug use, enrofloxacin should only be used as a second-line drug for colibacillosis in swine following consideration of other therapeutic options.

INDICATIONS:
Tenotryl™ is indicated for the treatment and control of swine respiratory disease (SRD) associated with *Actinobacillus pleuropneumoniae, Pasteurella multocida, Haemophilus parasuis, Streptococcus suis, Bordetella bronchiseptica* and *Mycoplasma hyopneumoniae*. Tenotryl™ is indicated for the control of colibacillosis in groups or pens of weaned pigs where colibacillosis associated with *Escherichia coli* has been diagnosed.

DOSAGE AND ADMINISTRATION:
Tenotryl™ provides flexible dosages and durations of therapy. Tenotryl™ may be administered for treatment and control of SRD or for control of colibacillosis. Administer, either by intramuscular or subcutaneous (behind the ear) injection, a single dose of 7.5 mg/kg of body weight (3.4 mL/100 lb). Administered dose volume should not exceed 5 mL per injection site.
For the control of colibacillosis, administration should be initiated within the first 60 days post-weaning when clinical signs are present in at least 2% of animals in the group. If no improvement is noted within 48 hours, the diagnosis should be reevaluated.

Table 1 – Dose Schedule for Swine

Weight (lb)	Dose Volume (mL)
15	0.5
30	1.0
50	1.7
100	3.4
150	5.1
200	6.8
250	8.5

Dilution of Tenotryl: Tenotryl™ may be diluted with sterile water prior to injection. The diluted product should be used within 24 hours. Store diluted solution in amber glass bottles between 5°C - 40°C (41°F - 104°F), excursions are not permitted.

Table 2 – Dilution Schedule*

Swine Weight	mL of Tenotryl™	mL of sterile water	Number of doses
10 lb	34 mL	66 mL	100
15 lb	51 mL	49 mL	100
20 lb	68 mL	32 mL	100
25 lb	85 mL	15 mL	100

*For 1 mL dose volume from diluted solution

Use within 30 days of first puncture and puncture a maximum of 30 times with a 16-gauge needle or smaller, or 4 times with a draw-off spike 4.75 mm or smaller. Any product remaining beyond these parameters should be discarded.

RESIDUE WARNINGS:
Swine: Animals intended for human consumption must not be slaughtered within 5 days of receiving a single-injection dose.

HUMAN WARNINGS:
Not for use in humans. Keep out of reach of children.

PRECAUTIONS:
The effects of enrofloxacin on swine reproductive performance, pregnancy and lactation have not been adequately determined.
The long-term effects on articular joint cartilage have not been determined in pigs above market weight.
Subcutaneous injection or intramuscular injection in swine can cause a transient local tissue reaction that may result in trim loss of edible tissue at slaughter.
Enrofloxacin injectable solution contains different excipients than other enrofloxacin products. The safety and efficacy of this formulation in species other than cattle and swine have not been determined.
Quinolone-class drugs should be used with caution in animals with known or suspected Central Nervous System (CNS) disorders. In such animals, quinolones have, in rare cases, been associated with CNS stimulation which may lead to convulsive seizures. Quinolone-class drugs have been shown to produce erosions of cartilage of weight-bearing joints and other signs of arthropathy in immature animals of various species. See Animal Safety section for additional information.

ADVERSE REACTIONS:
No adverse reactions were observed during clinical trials.
To report suspected adverse drug events, for technical assistance or to obtain a copy of the Safety Data Sheet, call 1-800-338-3659. For additional information about adverse drug experience reporting for animal drugs, contact FDA at 1-888-FDA-VETS or online at http://www.fda.gov/reportanimalae.

STORAGE CONDITIONS:
Protect from direct sunlight. Do not refrigerate or freeze.
Store at 20-30°C (68-86°F), excursions permitted between 15°C (59°F) to 40°C (104°F). Precipitation may occur due to cold temperature. To redissolve, warm and then shake the vial.

HOW SUPPLIED:
Tenotryl™ (enrofloxacin) Injectable Solution:

100 mg/mL	100 mL Bottle
100 mg/mL	250 mL Bottle
100 mg/mL	500 mL Bottle

Virbac AH, Inc.
PO Box 162059
Fort Worth, TX 76161
Rev. 12/21

Approved by FDA under ANADA # 200-688
TENOTRYL is a trademark of Virbac S.A.

AASV news continued from page 209

Resource reminder: Resource Directory for early-career veterinarians

The Early Career Committee compiled a list of veterinarians and others who may be able to offer expertise, knowledge, or serve as a resource for early-career veterinarians should they have questions about a specific topic. Example topics include diseases, diagnostics, ventilation, finances, and leadership.

This resource directory is available to all AASV members at **aasv.org/members/only/ecc/resources.pdf**. Contact information for AASV members can be found in the AASV Member Directory at **aasv.org/directory**.

AASV Foundation GOLF OUTING

Join us

Wednesday, August 23

11 AM – 6 PM

Veenker Memorial Golf Course
2916 Veenker Drive, Ames, Iowa

veenkergolf.com

REGISTRATION FORM

☐ **INDIVIDUAL registration - $125.00**
(per person - includes 18 holes of golf, golf-cart rental, refreshments, box lunch, and closing dinner)

☐ **TEAM registration - $500.00**
(group of four - list names below)

1. _____
2. _____
3. _____
4. _____

Name _____
Address _____
City, State, Zip _____
Email _____

Register by August 9th to reserve your spot.
Return this form with payment to
AASV Foundation, 830 26th Street, Perry, IA 50220
or register online at **aasv.org/foundation/golf**.

Let's golf!

Golfers, it is time to recruit and register your golf team to support the AASV Foundation!

Join your colleagues at the annual AASV Foundation Golf Outing on **Wednesday, August 23** at Veenker Memorial Golf Course in Ames, Iowa. Veenker has a history of providing lovely weather, great food, and a well-groomed course for golfers to enjoy at this event. Register today and plan to spend a fun day in support of the foundation.

Everyone is welcome! AASV members, industry stakeholders, clients, staff, family, and friends are all invited to register a 4-person team for this 18-hole, best-ball tournament. Individual golfers and pairs are also welcome and will be assigned to a team. The registration fee ($125 per golfer/$500 per team) includes 18 holes of best-ball golf, cart, lunch, beverages, awards dinner, and prizes. Preregistration is required by August 9 to reserve your spot.

Golfer check-in and warm-up on the driving range begins at 11:00 AM, followed by a shotgun start at noon. Golfers compete as a foursome in addition to participating in individual games and contests hosted by sponsors at various holes across the course.

Lunch, sponsored by **Merck Animal Health**, is provided to golfers before they tee off and beverage tickets supplied by **Zoetis** will help golfers stay hydrated throughout the afternoon. At the conclusion of the afternoon, scores will be tallied, ties will be broken, and the team and individual contest winners will be announced by event coordinator Dr Josh Ellingson during the pork dinner sponsored by **Boehringer Ingelheim Animal Health**.

Funds raised by the event support AASV Foundation programs, including research grants, travel stipends for students attending the AASV Annual Meeting, swine externship grants, scholarships for veterinarians pursuing board certification in the American College of Animal Welfare, student debt relief scholarships, AASV heritage videos, and more. Thanks to strong sponsorship support and golfer participation, last year's outing raised nearly $13,000 for the foundation!

For a sneak peek at the golf course, visit **veenkergolf.com**. For more information or to register, see **aasv.org/foundation/golf**, or contact AASV by phone, 515-465-5255, or email, **foundation@aasv.org**.

The American Association of Swine Veterinarians is committed to providing members with resources to promote and enhance well-being - the state of being comfortable, healthy, and happy.

The nine dimensions

Well-being isn't a single measure of health.

It is composed of nine unique dimensions that touch upon every aspect of our lives: occupational, intellectual, spiritual, social, emotional, physical, financial, creative and environmental. These dimensions work together, and collaboratively contribute to our overall well-being.

Intellectual
Learning new things; participating in activities that foster critical thinking and expand your worldviews.

Environmental
Taking an active role in preserving, protecting, and improving the environment.

Social
Surrounding yourself with a network of support built on mutual trust, respect, and compassion.

Emotional
Being able to identify and manage your full range of emotions, and seeking help when necessary.

Physical
Taking care of your body (e.g., getting enough sleep, eating a well-balanced diet, exercising regularly).

Financial
Being aware of your personal finances and adhering to a budget that enables you to meet your financial goals.

Creative
Participating in diverse cultural and artistic experiences.

Occupational
Being engaged in work that gives you personal satisfaction, and aligns with your values, goals, and lifestyle.

Spiritual
Having a sense of inner harmony and balance.

aasv.org/resources/wellbeing

First meeting of the AASV Early Career Development Program

Last fall, AASV was announced as a recipient of a $202,548 Education, Extension, and Training grant from the US Department of Agriculture National Institute of Food and Agriculture Veterinary Service Grants Program to create and deliver a participant-led, early-career swine veterinarian development program. These awards are intended to help mitigate food-animal veterinary service shortages in the United States. After the AASV Early Career Committee identified the need for additional education and training for swine veterinarians early in their careers, they quickly formed a subcommittee to develop a plan and a program to do just that.[1]

The goal is to create a participant-led program to provide resources needed to encourage and ensure successful, lifelong careers as swine veterinarians and to cultivate new leaders in swine veterinary medicine. Facilitated by Dr Clayton Johnson, AASV's program will deliver coursework and training through 5 in-person educational modules to be held April 2023 through July 2024 and a half-day, early-career conference in fall 2024.

The participants met for the first time during Module 1, held April 5-6 at the Iowa State University (ISU) Research Park in Ames, Iowa. Of the 25 participants, 23 attended in person and 2 attended virtually.

As requested by the AASV Board of Directors, the first module covered communications training. With support from Elanco Animal Health, Dr Heidi Hulon presented Insights Discovery. According to Insights, "The Insights Discovery methodology uses a simple and memorable four-color model to help people understand their style, their strengths, and the value they bring to the team." Consistent with the goals for the first module, Insights Discovery is designed to "help people understand themselves, understand others, and make the most of the relationships that affect them in the workplace."[2]

Participants completed an assessment prior to meeting in Ames, but first learned their "color energies" during Module 1. They spent Wednesday afternoon and Thursday morning engaged in group activities to better learn how to identify their own communication preferences, identify communication preferences of others, and practice new skills.

Those with a Cool Blue color energy are often task-focused, calm under pressure, and are thoughtful and objective. Their Insights colorful statement is, "Let's do it **right**." Those with a Fiery Red color energy generally enjoy high activity, working with others, and focusing on facts. Their Insights colorful statement is, "Let's do it **now**." Those with a Sunshine Yellow energy seem sociable, considerate of others, action-oriented, and entertaining. Their Insights colorful statement is, "Let's do it **together**." Finally, those with an Earth Green color energy prefer depth in relationships, harmony, and a consensus of all involved. Their Insights colorful statement is, "Let's do it with **care**."[3]

Participants arranged themselves based on their dominant color energy.

Advocacy in Action continued on page 217

UNITED ANIMAL HEALTH

WE ♡ MOMS

Systemwide performance starts with the sow.

Strong sow research can change your system.

UnitedAnH.com/Mother

Advocacy in Action continued from page 215

This group of swine veterinarians was divided almost equally among all four colors, although Cool Blue dominated (Figure 1). Most veterinary audiences, representing all species, are predominantly Earth Green.

In addition to educational content, a key outcome of this program is a strong peer network. To amplify the development of those relationships, each module includes an in-person social event. Participants, program facilitators, and speakers enjoyed each other's company during a casual meal and bowling at Perfect Games, conveniently located next to the group's hotel.

Finally, the group was invited to attend the ISU Swine Debate Club on Thursday at noon. The participants who were able to stay in Ames a bit longer were treated to lunch provided by the club. Attendees heard about continued improvements in oral fluid sampling from Dr Grzegorz Tarasiuk and an update on the US Swine Health Improvement Plan (US SHIP) and the ISU Veterinary Diagnostic Laboratory construction from Dr Rodger Main.

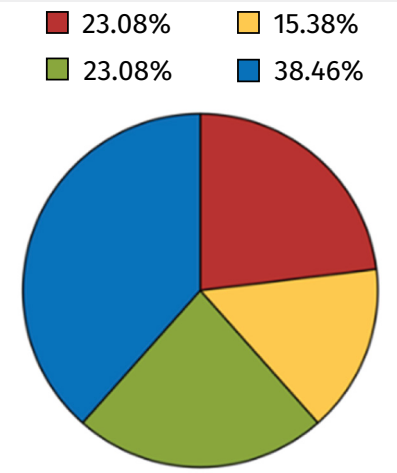
Almost all participants agreed this module made them more aware of personal communication preferences, helped them understand how to communicate with individuals with a different communication preference, and improved their ability to think about intentional communication and innate tendencies. All participants said they would recommend this module to other early-career swine veterinarians.

Future modules will cover topics selected by participants and take place in different geographic regions. View a list of participants at **aasv.org/news/story.php?id=15663**.

This is one example of the great work committees undertake to provide benefits to all AASV members. If you are interested in learning more about committee activities or are considering joining a committee, please contact the AASV office at **aasv@aasv.org**.

Abbey Canon, DVM, MPH, DACVPM
Director of Public Health and Communications

Figure 1: AASV Early Career Development Program participant's dominant color energies.



References

*1. AASV News. USDA-NIFA grant supports AASV's participant-led, early-career swine veterinarian development program [editorial]. J Swine Health Prod. 2022;30(6):371.

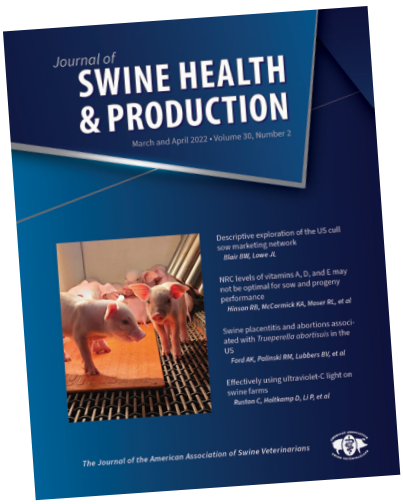
*2. Insights Discovery. The Insights Group Limited. Accessed May 2023. **https://www.insights.com/us/products/insights-discovery**

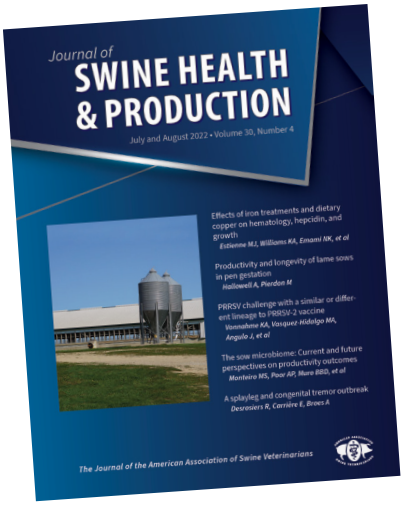
*3. The Insights Group Ltd. Insights Discovery mini reference guide. 2013-2020.

* Non-refereed references.

Participants engaged in group activities focused on identifying their communication preferences, identifying communication preferences of others, and practicing new skills.

Pigs of #instaham





Share your pig photos for the JSHAP cover

Submissions by readers are welcome!

- Photos must represent healthy pigs and modern production facilities and not include people.
- Photos must be taken using the camera's largest file size and highest resolution.
- Please send the original image(s); do not resize, crop, rotate, or color-correct the image prior to submission.
- Submit photos with your name and affiliation to **tina@aasv.org**.

UPCOMING MEETINGS

Webinar: Animal Depopulation Resiliency Tool

July 13, 2023 (Thu)
Webinar: 12:00 - 1:00 PM CDT
Speaker: Elizabeth B. Strand, PhD, LCSW

For more information:
Web: **us02web.zoom.us/webinar/register/WN_1Nhs69N_TSGi7IUzguxyyA#/registration**

AVMA Convention

July 14 - 18, 2023 (Fri-Tue)
Denver, Colorado

For more information:
Web: **avma.org/events/avma-convention**

Carthage Veterinary Service 33rd Annual Conference

August 29, 2023 (Tue)
Oakley-Lindsay Center
Quincy, Illinois

For more information:
Web: **conference.hogvet.com**

Allen D. Leman Swine Conference

September 16 - 19, 2023 (Sat-Tue)
Saint Paul, Minnesota

For more information:
Web: **lemanconference.umn.edu**

Pig Research Summit - THINK Piglet Health & Nutrition 2023

September 21 - 22, 2023 (Thu-Fri)
Crowne Plaza Copenhagen Towers
Copenhagen, Denmark

For more information:
Danish Agriculture & Food Council
Web: **tilmeld.dk/thinkpiglet2023/conference**

Pain in Animals Workshop 2023

September 26 - 27, 2023 (Tue-Wed)
National Institutes of Health
Bethesda, Maryland

For more information:
Web: **paw2023.com**

127th US Animal Health Association Annual Meeting

October 12 - 18, 2023 (Thu-Wed)
Gaylord National Resort and Convention Center
National Harbor, Maryland

For more information:
Web: **usaha.org/meetings**

American Association of Swine Veterinarians 55th Annual Meeting

February 24 - 27, 2024 (Sat-Tue)
Gaylord Opryland Resort and Convention Center
Nashville, Tennessee

For more information:
American Association of Swine Veterinarians
830 26th Street
Perry, Iowa 50220
Tel: 515-465-5255
Email: **aasv@aasv.org**
Web: **aasv.org/annmtg**

27th International Pig Veterinary Society Congress & 15th European Symposium of Porcine Health Management

June 4 - 7, 2024 (Tue-Fri)
Congress Centre Leipzig
Leipzig, Germany

For more information:
Web: **ipvs2024.com**

For additional information on upcoming meetings: aasv.org/meetings

AASV Industry Support Council

The Journal of Swine Health and Production **is made possible by the generous support of these Industry Support Council members:**

JSHAP Resources

AASV resources _____ aasv.org

Author guidelines _____ aasv.org/shap/guidelines

Journal of Swine Health and Production _____ aasv.org/shap

Membership information _____ aasv.org/aasv/membership

Subscription information _____ ecom.aasv.org/journal

Upcoming meetings _____ aasv.org/meetings

Industry Support Council member info _____ aasv.org/shap/advertising.php