Journal of
SWINE HEALTH & PRODUCTION

March and April 2025 • Volume 33, Number 2

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.

Opinions expressed in this publication are those of the individual authors and do not necessarily reflect the endorsement, official attitude, or position of the American Association of Swine Veterinarians, the *Journal of Swine Health and Production*, or any Industry Support Council member.

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: jshap@aasv.org.

DISCLAIMER

Journal of Swine Health and Production is indexed in CAB Abstracts, Google Scholar, Web of Science SCIE, and CrossRef

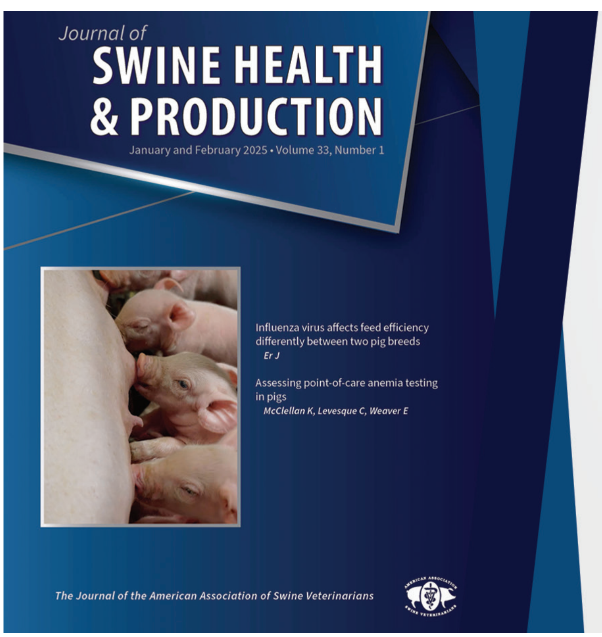
JOURNAL OF SWINE HEALTH AND PRODUCTION

(ISSN 1537-209X) Volume 33, Number 2; March and April

TABLE OF CONTENTS

Cover photo is courtesy of Tina Smith (*taken at University of Missouri*).

Download this issue at **www.aasv.org/shap/issues/v33n2/v33n2jshap.pdf**



JSHAP SPOTLIGHT

New JSHAP feature

Online Manuscript Submission and Peer Review

Submitting a manuscript to the *Journal of Swine Health and Production* and serving as a peer reviewer just got easier! We are excited to announce that JSHAP is now using ScholarOne software to facilitate online manuscript submission, peer review, and editorial processes. This software allows authors to submit and check the status of their manuscripts, allows reviewers to securely access assigned manuscripts and submit their review, and journal staff to easily manage the peer review and editorial process and communications. Authors can submit manuscripts online at **mc04.manuscriptcentral.com/jshap**. Register to serve as a scientific reviewer for JSHAP at **uoguelph.eu.qualtrics.com/jfe/form/SV_3q6Wc4gJKegOGGh**.

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

A mighty force for good

We are a mighty force for good. It takes all active members of the American Association of Swine Veterinarians to make measurable improvements for the good of the clients we serve and the animals in our care. The AASV continues to be focused on helping veterinarians prepare and execute tough decisions and solve difficult problems. Serving on the AASV Executive Committee has given me a fresh perspective of just how difficult it is to make progress on some of the most difficult problems before us.

Many of the challenges we face will only be overcome by working together with active communication throughout the industry. We cannot afford to operate individually and make all the same mistakes on our own. We also owe it to the pigs in our care to continually search for better results. We are fortunate to have strong leadership in our association at many levels. The investments made by decades of AASV members to support student member programs and early-career development have brought forward a strong group of young veterinarians that are championing new efforts in animal care and welfare.

The AASV Board of Directors continues to review, debate, and direct programs in support of many ongoing initiatives. If you are not engaged in these initiatives directly through committee work, you may consider providing support through writing and publishing a case study or offering your experience and time by serving on the Annual Meeting Program Planning Committee. Some of the initiatives the association is actively engaged in include:

- Advanced biosecurity improvements and evaluations
- Influenza diagnostics and H5N1 industry engagement
- Animal welfare evaluations and innovation
- African swine fever prevention and global vaccination
- Industry efforts to further drive porcine epidemic diarrhea virus elimination
- Early-career veterinarian development program

"Many of the challenges we face will only be overcome by working together with active communication throughout the industry."

There are many more initiatives and areas of focus that the association's various committees and task forces are engaged in. Almost all committees need additional members who are swine veterinary practitioners. If you are interested in learning more about the committee activities, visit the committee web pages on the AASV website (**aasv.org/members/only/committee**). Contact a committee chair or the AASV office to join a committee. We are blessed with many members willing to volunteer their voice, experience, and time to further these and many more efforts.

William L Hollis, DVM
AASV President

Problems large and small – solutions require us all

I sincerely appreciate and thank you for the opportunity to serve the association that has given me so much. It is an amazing time to be involved in agriculture, animal care, and veterinary medicine with new influences, animal care technologies, and roles for the animals we treat in our society. A common characteristic of the AASV membership seems to be that many are adept problem solvers. While no one really confesses to wanting more problems, there are many of us that thrive on identifying and digging into problems large and small.

That is fortunate because among all the reasons to be optimistic about the future of our profession, there are a few significant problems to tackle. First, our education system is evolving, and we are not responding fast enough to changes that will reduce the likelihood of student exposure to swine medicine as a career option or limit access to the level of training that most entry-level swine veterinary jobs require. As an organization, we must engage and drive standards for swine medicine training. If we do not, swine medicine education will continue to erode and disappear.

Second, the "keep your head down", work hard with humility, don't rock the boat, introverted characteristics that seem to be selected for in the veterinary training pipeline tend to work against proactively engaging society and promoting our value at protecting public health. The absence of understanding or appreciation of the value of highly trained, board-tested, legislatively regulated, science-based veterinarians has allowed the public's relationship with us to become mostly transactional. This change in relationship has given rise to movements to establish midlevel paraprofessionals who are held to less rigorous training standards and professional oversight.

Third, swine medicine has moved from being one of the highest compensated veterinary specialties to nearly the lowest compensated veterinary specialty over the past 20 years. Job satisfaction and employment decisions are complex and multifactorial, but compensation is certainly a very important piece of those decisions. Does this shift accurately reflect our *actual* value, our *perceived* value, or our reluctance to press the issue?

One thing I have learned as a team member inside and outside of veterinary medicine is that problem solvers, especially successful ones, are good at finding and pointing out problems! To people that are not energized by problem solving, this characteristic can very easily be viewed as critical or negative and can demotivate team members and allies that might help us. More important than the specific problems I have mentioned are how, and who, we engage in the process. It is easy to identify challenges, but it takes much more investment and participation to find solutions. For the challenges I have outlined, we must be involved and engaged in areas, and with groups, that we historically have not.

"It is easy to identify challenges, but it takes much more investment and participation to find solutions."

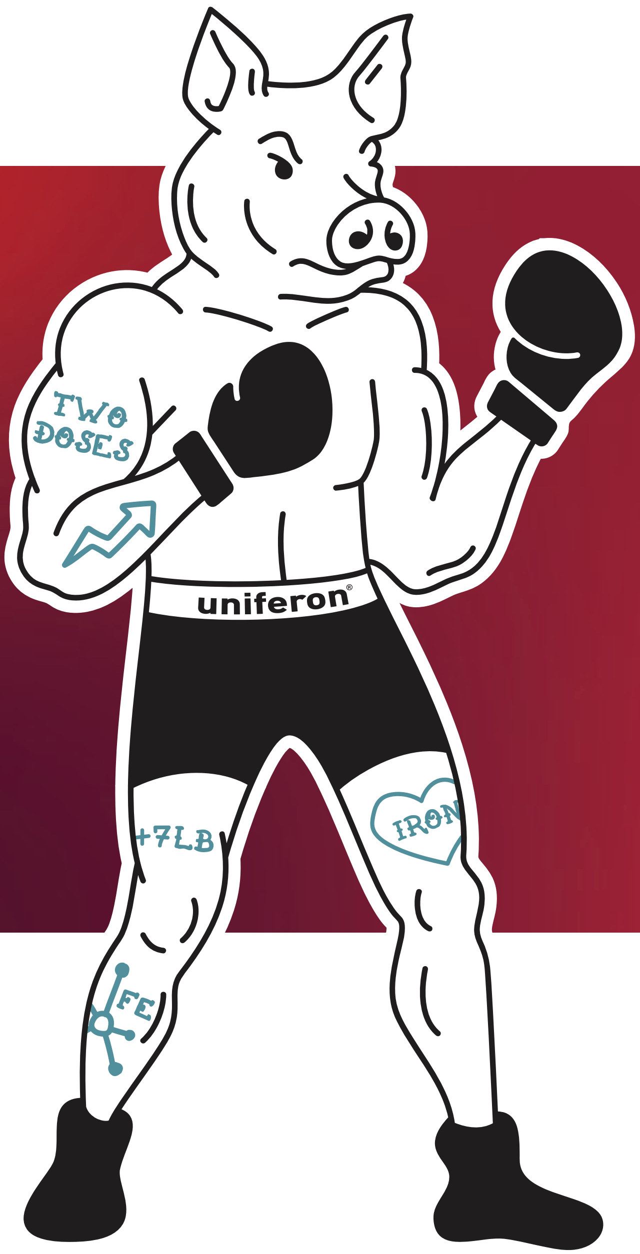
Engaging the social scientists to understand career decisions, challenging the educational accreditation authorities to facilitate swine clinical training, and proactively participating in grassroots educational programs that emphasize the role of swine veterinarians will be required. It might be uncomfortable, but it will be transformative.

Over the years, swine medicine and swine veterinarians have reinvented themselves through many challenges and transformations. I cannot think of a better group than AASV to embark with on the journey ahead!

Locke Karriker, DVM, MSc, DACVPM
AASV President-Elect

Turn your baby pigs into heavyweight champs

with two doses of **uniferon®200**
Iron(III) Dextran*



Your one-two punch for healthier baby pigs and a healthier bottom line.

↑ 1.0 lb heavier at weaning	↑ 2.3 lbs heavier at end of nursery
↑ 7.0 lbs heavier at marketing	↑ 5% increase in ADG

Visit PIGIRONBOOST.COM to learn more

*Prevention: 1mL (200 mg iron) at 1-3 days of age. Treatment: 1mL (200mg of iron) at the first signs of Iron deficiency.

 Gomez Cruz, F.A. et al. (2024). AASV Annual Conference.

PM-077-00

Planning for an H5N1 outbreak in swine

As H5N1 continues to spread in the bovine and poultry populations, swine producers and veterinarians have become concerned about the implications of movement restrictions like those seen in the dairy industry being imposed on swine producers. Similar restrictions within a production flow would likely result in the need for depopulation of swine herds. This would obviously have negative animal and human welfare concerns as well as economic impacts.

To address these concerns, the industry has come together to develop a response strategy if a highly pathogenic influenza virus should find its way into the US swine herd. Along with the National Pork Producers Council (NPPC), the National Pork Board, and the Swine Health Information Center, AASV collaborated to develop recommendations to help guide the swine industry response if necessary. This effort, spearheaded by Dr Anna Forseth with NPPC, has involved a broad-based working group composed of representatives from all facets of the swine industry including producers, packers, veterinarians, researchers, and regulatory agencies.

This working group has met regularly since late August 2024 with excellent participation and ownership of the development process.

The final draft of the document has been circulated for comment to multiple groups including the AASV Influenza Committee, as well as representatives from state and federal animal health officials and public health organizations. This document focuses specifically on highly pathogenic influenza viruses that have a regulatory response in other species. It emphasizes that any response should be based on the strain of the virus and its potential for transmission. The objective of the document is to minimize the spread of the virus, protect animal and human health, and maintain business continuity in the swine industry. Specifically, it is intended to provide a uniform and science-based response to aid state and federal animal health officials enact response programs to manage the disease with the goal of eliminating the virus from the US swine herd.

The document attempts to describe what an H5N1 infection in swine might look like clinically and provides a proposed case definition. The bulk of the document focuses on a detailed list of response guidelines based on herd type and aspect of production (ie, biosecurity, transportation, animal movements, etc). It provides a science-based strategy for monitoring affected herds and those in close proximity or with possible direct or indirect contact. In addition, it includes a section on worker safety and public health considerations recognizing the potential for human exposure and possible illness.

"The objective of the document is to minimize the spread of the virus, protect animal and human health, and maintain business continuity in the swine industry."

The goal of this effort is to have a guidance document available and vetted with as many stakeholders as possible prior to a highly pathogenic influenza outbreak in swine. Following review by various stakeholder groups and incorporation of any pertinent comments, the final draft was presented to US Department of Agriculture (USDA) personnel in late January in hopes that they would accept it as a resource for response planning in the event of an outbreak. It was well received by USDA and, at the time of publication, we are awaiting the results of their review.

I think this is an excellent example of the proactive approach the swine industry has taken to address potentially significant disease challenges. Kudos to those who were instrumental in bringing together such a diverse group of stakeholders and experts. And, thanks to those who freely gave their time to bring this effort to fruition. Now, let's hope we never have to use it.

Harry Snelson, DVM
Executive Director


SOW

Open call for JSHAP Special Topics: PEDV

The *Journal of Swine Health and Production* (JSHAP) is pleased to announce the launch of a new initiative aimed at addressing timely and critical challenges within the swine industry, a Special Topics section. This section will debut during 2025, and we invite researchers, practitioners, and industry experts to contribute their work.

Why a Special Topics section?

The swine industry is dynamic and constantly evolving in response to new challenges and opportunities. Whether emerging diseases, advancements in production practices, or shifting market dynamics, addressing these issues through collaborative research and shared knowledge is essential. The intent of the Special Topics section is to spotlight an issue of significant importance to the swine industry, foster dialogue, and provide evidence-based solutions to current and future challenges. The inaugural Special Topics section will focus on **porcine epidemic diarrhea virus (PEDV).** Details can be found at **aasv.org/jshap-special-topics**.

This new section will provide veterinarians, researchers, and industry professionals with the latest knowledge and evidence-based strategies to address the challenges posed by PEDV to swine health and production systems. As we know, PEDV continues to be a significant threat to the global swine industry due to its high morbidity and mortality in neonatal piglets, along with its economic and welfare implications. This special section seeks to advance understanding and foster collaboration by addressing critical areas of PEDV research and application, including but not limited to:

Epidemiology and transmission: Updates on PEDV spread within and between herds, risk factors, and implications for biosecurity.

Pathogenesis and immunology: Advances in understanding PEDV infection, immunity, and long-term herd-level impacts.

Diagnostics: Development and application of novel diagnostic methods to enhance disease detection and monitoring.

Vaccination and therapeutics: Evaluations of current vaccines and treatments, including their efficacy in diverse production systems.

Management and biosecurity practices: Evidence-based approaches for outbreak prevention and response.

Economic and industry impacts: Quantitative assessments of PEDV's financial burden and cost-benefit analyses of control measures.

Case report and studies: Insights from regional outbreaks and comparative studies with other swine coronaviruses.

Open call for manuscripts

We invite submissions that align with the Special Topics theme and advance the knowledge and management of PEDV in swine health and production.

The following manuscript genres are accepted by JSHAP: original research, brief communication, case report, case study, literature review, production tool, diagnostic note, practice tip, and commentary. Detailed descriptions and formatting requirements for each genre are available in our Author Guidelines (**aasv.org/author-guidelines**).

Authors should clearly indicate in their cover letter that their submission is for the Special Topics section. All submissions will undergo the journal's rigorous peer-review process to ensure the highest standards of quality and relevance.

The inaugural Special Topics timeline is:

- **Manuscript submission deadline:** Ongoing through February 2, 2026.
- **Peer review and revision period:** Ongoing through the submission period.
- **Publication date:** Accepted manuscripts will be published online ahead of print upon completion of copyediting and compiled into JSHAP issues throughout the year.

Join the conversation

This Special Topics section will provide a valuable platform for showcasing innovative research and solutions to a key challenge facing the swine industry. By submitting a manuscript, you have the opportunity to help shape the future of swine health and production while highlighting the critical work being done in our community.

We look forward to your submissions and working together to make the inaugural Special Topics section a success. If you have questions or need further information, please reach out to our journal staff.

Thank you for your continued support of JSHAP and for your commitment to advancing the swine industry.

Terri O'Sullivan, DVM, PhD
Executive Editor

Hematological parameters of pigs in different housing systems in Slovenia

Irena Golinar Oven, Jan Plut, Melita Hajdinjak, Tim Šteferl, Eva Nadlučnik, Marina Štukelj

Abstract

Objectives: Establish blood reference values and evaluate the influence of age on the hematological profile of indigenous Slovenian Krškopolje pigs and compare these values with conventionally farmed pigs.

Materials and methods: Blood samples were taken from 57 grower and 36 finisher Krškopolje pigs from 2 organic farms and 183 grower and 47 finisher pigs from 6 conventional farms in Slovenia. Samples were analyzed using an automatic hematology analyzer to measure white blood cell count, red blood cell count (RBC), hematocrit (Hct), hemoglobin concentration (Hb), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), and platelet count (PLT).

Results: The hematological parameter reference values of the Krškopolje pig breed corresponded with reference ranges in the literature. Pig age had a significant effect on hematologic parameters. Organic grower pigs had significantly higher RBC and MCHC values and lower Hct, MCV, and MCH values than conventional pigs. Organic finisher pigs had significantly higher PLT values and lower Hb, Hct, MCV, and MCH values than conventional pigs. All reported differences in hematologic values between Krškopolje and conventional pigs are not expected to affect clinical outcomes.

Implications: These hematologic reference values can be used as a diagnostic tool for assessing the health status of Krškopolje pigs, but pig age must be accounted for. Reference values from the literature are suitable for assessing the health status of both conventionally and organically reared pigs.

Keywords: swine, hematology, reference values, indigenous pig breed, conventional breed

Received: May 13, 2024
Accepted: September 16, 2024
Published online: January 23, 2025

Resumen - Parámetros hematológicos de cerdos en diferentes sistemas de alojamiento en Eslovenia

Objetivos: Establecer valores de referencia en sangre y evaluar la influencia de la edad en el perfil hematológico de cerdos Krškopolje autóctonos eslovenos y comparar estos valores con cerdos de granja convencional.

Materiales y métodos: Se tomaron muestras de sangre de 57 cerdos Krškopolje de engorde y 36 cerdos de engorde de 2 granjas ecológicas, y de 183 cerdos de engorde, y 47 cerdos de engorde de 6 granjas convencionales de Eslovenia. Las muestras se analizaron utilizando un analizador automático de hematología para medir el recuento de glóbulos blancos, el recuento de glóbulos rojos (RBC), el hematocrito (Hct), la concentración de hemoglobina (Hb), el volumen corpuscular medio (MCV), la hemoglobina corpuscular media (MCH), la concentración media de hemoglobina corpuscular (MCHC), y el recuento de plaquetas (PLT).

Resultados: Los valores de referencia de los parámetros hematológicos de la raza porcina Krškopolje correspondieron con los rangos de referencia de la literatura. La edad del cerdo tuvo un efecto significativo sobre los parámetros hematológicos. Los cerdos de engorde orgánicos tuvieron valores significativamente más altos de RBC y MCHC, y valores más bajos de Hct, MCV, y MCH que los cerdos convencionales. Los cerdos de engorde orgánicos tuvieron valores de PLT significativamente más altos y valores más bajos de Hb, Hct, MCV, y MCH que los cerdos convencionales. No se espera que todas las diferencias detectadas en los valores hematológicos entre Krškopolje y los cerdos convencionales afecten los resultados clínicos.

Implicaciones: Estos valores de referencia hematológicos pueden utilizarse como herramienta diagnóstica para evaluar el estado de salud de los cerdos de Krškopolje, pero hay que tener en cuenta la edad de los cerdos. Los valores de referencia de la bibliografía son adecuados para evaluar el estado sanitario de los cerdos criados tanto de forma convencional como ecológica.

IGO, JP, TŠ, EN, MŠ: Clinic for Ruminants and Pigs, Clinic for Reproduction and Large Animals, Veterinary Faculty, University of Ljubljana, Ljubljana, Slovenia.

MH: Laboratory of Applied Mathematics and Statistics, Faculty of Electrical Engineering, University of Ljubljana, Ljubljana, Slovenia.

Corresponding author: Dr Irena Golinar Oven, Veterinary Faculty, University of Ljubljana, Gerbičeva 60, 1000 Ljubljana, Slovenia; Tel: (+ 386) 1 4779 207; Email: **irena.golinaroven@vf.uni-lj.si**

Golinar Oven I, Plut J, Hajdinjak M, Šteferl T, Nadlučnik E, Štukelj M. Hematological parameters of pigs in different housing systems in Slovenia. *J Swine Health Prod*. 2025;33(2):56-61. **https://doi.org/10.54846/jshap/1410**

Résumé - Paramètres hématologiques de porcs dans différents systèmes d'hébergement en Slovénie

Objectifs: Établir les valeurs de référence sanguines et évaluer l'influence de l'âge sur le profil hématologique de porcs indigènes slovènes Krškopolje et comparer ces valeurs avec celles de porcs élevés en fermes conventionnelles.

Matériels et méthodes: Des échantillons de sang ont été obtenus de 57 porcs Krškopolje en croissance et de 36 porcs Krškopolje en finition de 2 fermes biologiques et de 183 porcs en croissance et 47 porcs en finition de 6 fermes conventionnelles en Slovénie. Les échantillons ont été analysés au moyen d'un appareil hématologique automatique afin de mesurer le comptage leucocytaire, le comptage de globules rouges (RBC), l'hématocrite (Hct), la concentration en hémoglobine (Hb), le volume corpusculaire moyen (MCV), l'hémoglobine corpusculaire moyenne (MCH), la concentration moyenne d'hémoglobine corpusculaire (MCHC) et le comptage de plaquettes (PLT).

Résultats: Les valeurs de référence des paramètres hématologiques des porcs de race Krškopolje correspondaient avec les plages de référence dans la littérature. L'âge des porcs avait un effet significatif sur les paramètres hématologiques. Les porcs en croissance biologiques avaient des valeurs de RBC et de MCHC significativement plus élevées et des valeurs de Hct, MCV, et MCH plus basses que les porcs conventionnels. Les porcs en finition biologiques avaient des valeurs de PLT significativement plus élevées et des valeurs de Hb, Hct, MCV, et MCH plus basses que les porcs conventionnels. On ne s'attend pas à ce que toutes les différences hématologiques rapportées entre les porcs Krškopolje et les porcs conventionnels affectent des résultats cliniques.

Implication: Ces valeurs de référence hématologiques peuvent être utilisées comme outil diagnostique pour évaluer l'état de santé de porcs Krškopolje, mais l'âge des porcs doit être pris en compte. Les valeurs de référence obtenues de la littérature sont acceptables pour évaluer l'état de santé de porcs élevés de manière conventionnelle ou biologique.

Hematologic examination can be an important diagnostic tool for assessing the health status of pigs but is rarely performed. Blood sampling in pigs is difficult and causes stress, which is one of the main sources of hematologic variation.[1] Many reference intervals for pigs have been published, but the ranges for most hematologic parameters are quite wide. A variety of environmental and physiological factors must be considered when interpreting the results of hematology analyses, including age, sex, diet, stage of gestation, housing system, management practices, time of year, blood collection technique, sample preparation, and the type of analysis equipment used.[1-3]

The evaluation of hematological parameters in pigs can be valuable in the treatment or prognosis of many diseases,[4] can contribute to the early detection of pathological conditions, and reflect metabolic disorders due to nutrient deficiencies.[5-7] Diet can influence the hematologic values of animals and can be used as a suitable measure of long-term nutritional status.[8] In a trial conducted by Lee et al,[9] increasing the concentration of tannic acid (125 to 1000 mg/kg) in the weaning diet resulted in a linear reduction in red blood cell (RBC) count, hemoglobin (Hb), and hematocrit (Hct) on days 21 and 28 of treatment.

In recent years, a new generation of consumers has become enthusiastic about organic and free-range farming as an alternative to indoor farming, as they are perceived to be associated with health, sustainability, food safety, and animal welfare. The differences between organic and conventional pig farming lie in the breed, stocking density, animal husbandry, feeding, and treatment of diseases. Physical activity, a factor emphasized in organic and free-range farming, and different management methods, such as housing type, can influence blood values.[10] Slovenian pig farms are small and fragmented, agricultural land is limited, and natural conditions are not favorable for larger scale pig farms. Pig farming makes up a small part of Slovenian agriculture, as the self-sufficiency rate for pork is only 20% to 25%. Slovenia has 253,770 pigs kept on 12,843 farms. Only 22 of these farms are considered large with more than 1000 pigs and 11,631 farms are small with 20 or less pigs.[11]

The Krškopolje pig is the only preserved indigenous pig breed in Slovenia. The breed was threatened with extinction, but the promotion and support of organic farming has increased interest in the breed. The breed is adapted to poor rearing conditions, is robust, and is feed efficient making it suitable for outdoor production.[12] The average daily gain of the Krškopolje pig during the growth phase is lower than that of modern breeds.[13,14] Krškopolje pigs are reared in various housing systems including conventional indoor housing, outdoor housing with shelter, and indoor housing only in very cold winters.[12] Recently, there have been more organic farms in Slovenia using the Krškopolje pig breed, as its meat is highly appreciated by consumers.

The aims of this study were to establish hematological reference values for grower and finisher Krškopolje pigs to be used for clinical interpretation of laboratory data and evaluate the influence of age on hematological parameters. Additionally, this study compares hematological values of Krškopolje pigs with those of conventional pig breeds on Slovenian farms to determine whether any differences are clinically relevant.

Animal care and use

All procedures in this study were carried out in accordance with Directive 2010/63/EU of the European Parliament and the Council on the Protection of Animals used for Scientific Purposes and the Slovenian Animal Protection Law (Official Gazette of the Republic of Slovenia No. 38/2013 and 21/2018) and accepted by the National Ethics Committee. This study was carried out as a part of the ERA-Net CORE Organic Cofound project - Robust animals in sustainable mixed free-range systems project (ROAM-FREE) and was ethically approved by the Ministry of Agriculture, Forestry, and Food (U34401-6/2022/11).

Materials and methods

Farms and animals

The study was conducted in Slovenia between 2022 and 2023 on 2 organic farms (one with 180 animals and the other with 40 animals) and 6 conventional farms (2 large 1-site farms, with 1000 and 1850 breeding sows, respectively, one 2-site farm with 600 breeding sows, and 3 small 1-site farms each with 100 breeding sows). The animals from both organic farms originated from the same

Slovenian organic pig farm and were the indigenous Slovenian Krškopolje pig breed. The sows on the conventional farms were maternal hybrids (H12) with the dam from the Slovenian Landrace - Line 11 and the sire from the Slovenian Large White.

Organic housing systems are divided into indoor, outdoor, and mixed housing. The types of barns range from heated buildings with artificial ventilation to open-front barns. Organic standards require that animals are kept with outdoor access. In indoor housing, the pigs have access to an outdoor run. According to national rules and based on national interpretation of the EU regulations for organic farming (Council Directives 2007/834/EC and 2008/889/EC), outdoor runs vary from concrete and slatted floors to deep litter and from open to fully covered by a roof. In outdoor housing, the animals are kept outside all year round with shelter. In mixed housing systems, various combinations of indoor and outdoor housing are used. For finishing pigs weighing up to 50 kg, 0.8 m^2/head are required for the indoor area and 0.6 m^2/head for the outdoor area (excluding pasture). The total stocking density must not exceed 170 kg of nitrogen per year and hectare of agricultural area (the maximum number of finishing pigs per hectare is 14). The use of chemically synthesized allopathic veterinary medicinal products or antibiotics for preventive treatment is prohibited. The feed used in organic farming must come from organic production, at least 20% of which must come from the farm itself.

In our study, pigs on the larger organic farm were reared outdoors on a large grass pasture (9000 m^2) with 2 straw-bedded dugouts. A nipple drinker and feeder were provided. In winter, these pigs were housed indoors in a large pen bedded with straw. Pigs on the smaller organic farm were reared outdoors on a large grass pasture (12,600 m^2) and had one covered wooden shelter. The shelter was bedded with straw and had one water trough and one feed trough inside.

The conventional farms in our study were indoor farms, two small farms had outdoor runs for growers and finishers. All farms had a ventilation system. However, one small farm used natural ventilation most of the time because the ventilation system was not working properly. The floors in the conventional farms were partially slatted, with two small farms also having solid floors.

All farms had nipple and bowl drinkers, usually two in each pen. Two large farms had floor feeding, the others had hoppers and troughs. The size of the pen groups varied from 18 to 25 pigs/pen on all farms, but a minimum unobstructed floor area of 0.40 m^2 was provided for a growing pig (30-50 kg pigs).

On both the organic and conventional farms, the male piglets were surgically castrated in the first week of life. Piglets on organic farms received analgesia at castration.

Previous treatment

Pigs from conventional farms were vaccinated against *Mycoplasma hyopneumoniae*, porcine circovirus 2 (PCV2), and sows vaccinated against *Echerichia coli* and atrophic rhinitis. Pigs from organic farms were vaccinated against *Erysipelothrix rhusiopathiae.* Treatments against endoparasites and ectoparasites were carried out on all growing pigs from organic and conventional farms when they reached 25 to 30 kg. Fecal samples were collected and pooled from each farm and examined for internal parasites using flotation and sedimentation techniques; clinically insignificant levels of *Balantidium coli* were found on all farms. All farms were certified to be free of classical swine fever, African swine fever, pseudorabies, porcine reproductive and respiratory syndrome, *Clostridium perfringens C*, *Brachyspira hyodysenteriae,* and *Salmonella*. All piglets from organic and conventional farms were given 200 mg/mL iron in a dose of 1 mL (trivalent iron in the form of an iron hydroxide complex with dextran) intramuscularly in the first three days of life. Clinical examination of the herd was carried out during a site visit and animals were observed to be clinically healthy at the time of blood sampling.

Nutrition

On the conventional farms, breeding animals were fed twice daily and grower-finisher pigs were fed *ad libitum*, each with commercially produced feed. The diets contained corn, wheat, barley, and soybeans and were supplemented with complementary feed and mineral-vitamin mixtures according to NRC category recommendations.[15] Pigs on the organic farms were fed an organic diet consisting of 60% barley, 30% wheat, and 10% sunflower meal. Pigs on the small organic farm were fed twice daily, 35 kg of feed in the morning and 15 kg of feed in the afternoon. Pigs on the large organic farm were fed *ad libitum*.

No other additives (eg, therapeutics or nostrums) were added to the feed on any of the farms.

Blood sample collection

Blood samples were collected from 57 grower and 36 finisher pigs from organic farms and 183 grower and 47 finisher pigs from conventional farms. Grower pigs were 7 to 14 weeks of age. The animals were randomly selected and individual blood samples for hematological analysis were taken from the anterior vena cava in tubes containing K_3EDTA anticoagulant (Vacuette, Greiner Bio-One). The tubes were gently shaken by hand for 30 seconds to ensure mixing of blood and anticoagulant. The samples were transported in a box at 4°C and the analyses were performed on the day of sampling.

Hematological analyses

Individual blood samples were analyzed using an automated hematology analyzer, the scil Vet abc Plus (Horiba). The following hematologic variables were measured: white blood cell count (WBC), red blood cell count (RBC), hematocrit (Hct), hemoglobin concentration (Hb), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), and platelet count (PLT). The laboratory where the analyses were performed participated in the Randox International Quality Assessment Scheme Hematology Program.

Statistical analyses

Statistical analyses were performed using the R software package (version 4.3.2).[16] Bartlett's test was used to test for homoscedasticity, ie, whether multiple samples came from populations with equal variances. If the Bartlett's test for homoscedasticity on samples from different types of husbandry (organic farms versus conventional farms) gave $P \geq .05$, the null hypothesis that all population variances were equal was not rejected against the alternative that at least two were different. Therefore, Student's *t*-test and analysis of variance, which assume that the population variances are equal, were used to determine whether the type of husbandry affected the hematological parameters of the pigs. If Bartlett's test for homoscedasticity on samples from different types of husbandry practices gave $P < .05$, the null hypothesis that all population variances were equal was rejected against the alternative that at least two were different. Therefore, the variances were not considered equal, and the Welch's *t*-test (or unequal variances *t*-test) was used to test whether the different types of husbandry practices gave statistically different means for hematological parameters. Welch's *t*-test is a two-sample location test, an adaptation of the Student's *t*-test, which is more reliable when samples have unequal variances and possibly unequal sample sizes. The level of significance was set at $P < .05$.

Reference intervals were estimated using the refineR function in R, which implements the recently published, state-of-the-art indirect method.[17] It takes routine measurements of diagnostic tests as input and uses sophisticated statistical methods to derive a model describing the distribution of the non-pathological samples. The distribution is then used to derive reference intervals.

Results

The hematological values, the reference intervals of the Krškopolje pigs during the growing and finishing phase, and reference values from the literature are shown in Table 1. The hematological values for both age categories of Krškopolje pigs are within the reference values from the literature. Age significantly influenced values of WBC, Hb, Hct, MCV, MCH, and PLT.

Table 2 shows the hematological values of grower pigs from organic and conventional farms. The RBC and MCHC were significantly higher, and the Hct, MCV, and MCH were lower in grower pigs from organic farms than in pigs of the same age from conventional farms. Table 3 shows the hematological values of finisher pigs from organic and conventional farms. The PLT were significantly higher and Hb, Hct, MCV, and MCH were lower in finisher pigs from organic farms than those from conventional farms.

Discussion

Hematologic reference values for different age groups of pigs have already been reported,[2,3,5,18,19] especially for conventional pig breeds kept on conventional farms. In this study, hematological reference values for grower and finisher Krškopolje pigs were determined for the first time. When comparing hematological parameter values of grower and finisher Krškopolje pigs with the reference values from the literature,[1,20] no clinically relevant differences were found. Hematological reference values presented for the Krškopolje pig provide a basis for the interpretation of hematologic results

Table 1: Hematological values of grower (7-14 wk old) and finisher Krškopolje pigs from two organic farms and reference values from the existing literature

Parameter	Age	Mean (median)	Range*	*P*	Reference values (mean)
WBC, 10^9/L	Growers	24.01 (23.85)	16.22-30.35	< .001	13.70-34.12 (22.44)† 18.9-33.8 (26.9)‡
	Finishers	18.86 (17.95)	16.68-18.85		14.10-32.10 (20.97) †
RBC, 10^{12}/L	Growers	6.74 (6.72)	6.57-6.91	.07	5.40-7.28 (6.43)† 6.4-8.0 (7.1)‡
	Finishers	7.02 (7.04)	6.86-7.45		5.74-8.63 (6.92)†
Hb, g/dL	Growers	10.87 (10.90)	9.79-11.15	< .001	9.2-12.5 (10.9)† 11.5-13.3 (12)‡
	Finishers	11.87 (11.90)	11.59-12.17		11.1-14.4 (12.6)†
Hct, %	Growers	35.02 (35.20)	32.44-38.10	< .001	28.0-41.7 (35.3)† 38-44 (40)‡
	Finishers	38.14 (38.50)	36.73-39.81		34.1-48.7 (39.9)†
MCV, μm^3	Growers	52.02 (52.00)	50.25-55.39	.002	47.7-63.0 (54.9)† 53-61 (57)‡
	Finishers	54.61 (56.00)	56.93-58.93		50.0-64.8 (57.8)†
MCH, pg/cell	Growers	16.15 (16.20)	15.60-16.93	.001	14.0-18.5 (17.1)†
	Finishers	17.00 (17.35)	17.69-18.29		16.1-20.9 (18.4)†
MCHC, g/dL	Growers	31.06 (31.0)	30.37-31.25	.58	28.8-33.5 (31.1)† 28-31 (30)‡
	Finishers	31.12 (31.20)	30.94-31.41		29.2-33.7 (31.7)†
PLT, 10^9/L	Growers	427.12 (427.00)	362.10-508.41	.01	273-730 (483)†
	Finishers	369.06 (358.00)	330.92-350.42		134-584 (336)†

* 2.5^{th} to 97.5^{th} inter-percentile range.

† Reference ranges taken from Ježek et al.[3]

‡ Reference ranges taken from Thorn.[1] Both sexes were 3.5-4 months old.

WBC = white blood cell count; RBC = red blood cell count; Hb = hemoglobin concentration; Hct = hematocrit; MCV = mean corpuscular volume; MCH = mean corpuscular hemoglobin; MCHC = mean corpuscular hemoglobin concentration; PLT = platelet count.

Table 2: Hematological values of grower pigs on organic and conventional farms

Parameter	OF, Mean (SD)	CF, Mean (SD)	P		
			Bartlett	Student *t*	Welch *t*
WBC, 10^9/L	24.01 (6.85)	22.15 (6.12)	.29	.56	NA
RBC, 10^{12}/L	6.74 (0.67)	6.24 (0.87)	.02	NA	< .001
Hb, g/dL	10.87 (1.09)	11.25 (1.37)	.04	NA	.94
Hct, %	35.02 (3.57)	38.84 (5.01)	.003	NA	.002
MCV, μm^3	52.02 (3.33)	60.30 (4.42)	.01	NA	< .001
MCH, pg/cell	16.15 (1.05)	17.43 (1.22)	.16	< .001	NA
MCHC, g/dL	31.06 (0.54)	29.06 (1.44)	< .001	NA	< .001
PLT, 10^9/L	427.12 (110.75)	365.73 (147.00)	.01	NA	.17

OF = organic farms; CF = conventional farms; NA = not analyzed; WBC = white blood cell count; RBC = red blood cell count; Hb = hemoglobin concentration; Hct = hematocrit; MCV = mean corpuscular volume; MCH = mean corpuscular hemoglobin; MCHC = mean corpuscular hemoglobin concentration; PLT = platelet count.

Table 3: Hematological values of finisher pigs on organic and conventional farms

Parameter	OF, Mean (SD)	CF, Mean (SD)	P		
			Bartlett	Student *t*	Welch *t*
WBC, 10^9/L	18.86 (3.18)	20.11 (4.53)	.03	NA	.14
RBC, 10^{12}/L	7.02 (0.75)	6.85 (0.79)	.72	.33	NA
Hb, g/dL	11.87 (1.00)	12.76 (1.22)	.22	< .001	NA
Hct, %	38.14 (3.21)	40.62 (4.60)	.02	NA	.004
MCV, μm^3	54.61 (4.16)	59.67 (2.87)	.01	NA	< .00
MCH, pg/cell	17.00 (1.32)	18.69 (1.08)	.20	< .001	NA
MCHC, g/dL	31.12 (0.53)	31.31 (1.03)	< .001	NA	.26
PLT, 10^9/L	369.06 (101.29)	264.74 (101.66)	.98	< .001	NA

OF = organic farms; CF = conventional farms; NA = not analyzed; WBC = white blood cell count; RBC = red blood cell count; Hb = hemoglobin concentration; Hct = hematocrit; MCV = mean corpuscular volume; MCH = mean corpuscular hemoglobin; MCHC = mean corpuscular hemoglobin concentration; PLT = platelet count.

from individual animals or from herds with clinical signs or conditions that may be subclinical.

The results of our study show that the hematological parameters of Krškopolje pigs are age-associated; they differ significantly between two age groups (growers and finishers). This is consistent with previous results.[3,21] As this is a field study, we cannot say with certainty that the differences in hematological results are due to age rather than variables (eg, feed or facility types) associated with the age group.

Reference values were calculated separately for Krškopolje grower and finisher pigs, as the differing values of WBC, Hb, Hct, MCV, and PLT seem to be clinically relevant between these age groups. The mean hematological parameter values for grower and finisher pigs in this study differ from published reference values for sows, which can be attributed to physiological changes during the maturation process.[1,3,22]

In our study, we found significant differences in some hematological parameters between pigs raised on organic farms or conventional farms. Higher RBC values in pigs on organic farms could result from greater muscle activity, as pigs on organic farms had the ability to move more.[20] Pig breeds that grow faster may have a lower concentration of RBCs in their bloodstream. Due to rapid muscle development, blood volume increases while RBC production may not keep pace.[23] Grower and finisher pig Hct and finisher pig Hb were lower in Krškopolje pigs than in pigs from conventional farms. When finisher pigs reach the desired market weight, their metabolic requirements decrease, and blood Hb and Hct levels often decrease as well.[24] In our study, the finishers had not yet reached market weight, so Hb and Hct levels were still higher in the finishers than in the growers on both organic and conventional farms.

Diet can also contribute to differences in the hematological profile. The animals on the organic farm received organically produced feed (barley, wheat, and sunflower seeds), with the grower and finisher pigs receiving the same diet. Free-range farming with grazing systems facilitates a natural lifestyle but carries a higher risk of nutrient leaching.[25] For example, lower Hb and Hct values in organic farms could be due to a lack of protein in the feed; lower Hb values also occur in the case of amino acid deficiencies and chronic parasitic diseases.[20] Pigs from organic farms had significantly higher PLT values. The number of PLT fluctuate due to physiological adaptations to physical exertion (increasing considerably after hard work), seasons (increasing in colder temperatures), and altitudes (increasing at higher altitudes).[20] The animals on the organic farms were more physically active, as they had larger space allowance. Both organic farms were located at an altitude between 556 and 700 m above sea level. The conventional farms were located at an altitude of 163 to 380 m above sea level, which could have contributed to their lower PLT values. Significant differences between pigs of the same age raised on organic or conventional farms may also be due to differences in the breed of the animals.

Despite the identified changes in some hematological parameters between Krškopolje pigs raised on organic farms and pigs raised on conventional farms, all hematological values were within published reference values.[3,20] Therefore, we do not expect that the differences in hematological values observed in this study will be reflected in the health status of the pigs.

Implications

Under the conditions of this study:

- Reference values help interpretation of hematological results for pig health.
- Age-related changes in hematological parameters occurred.
- Published reference values are suitable for organic and conventional farmed pigs.

Acknowledgments

We wish to express our gratitude to farm personnel, farm owners, the local veterinarians, and veterinary students for their help in conducting this study.

This study was cofunded by the European Union under the ERA-NET CORE Organic project robust animals in sustainable mixed free-range systems (ROAM-FREE) and the Slovenian Research and Innovation Agency (ARIS) under the research program P4-0092 – Animal health, environment and food safety.

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. Thorn CE. Hematology of the pig. In: Weiss DJ, Wardrop KJ, Schalm OW, eds. *Schalm's Veterinary Hematology.* 6th ed. Wiley Blackwell; 2010:843-851.

2. Friendship RM, Lumsden JH, McMillan I, Wilson MR. Hematology and biochemistry reference values for Ontario swine. *Can J Comp Med.* 1984;48:390-393.

3. Ježek J, Starič J, Nemec M, Plut J, Golinar Oven I, Klinkon M, Štukelj M. The influence of age, farm, and physiological status on pig hematological profiles. *J Swine Health Prod.* 2018;26(2):72-78. **https://doi.org/10.54846/jshap/1049**

4. Eze JI, Onunkwo JI, Shoyinka SVO, Chah FK, Ngene AA, Okolinta N, Nwanta JA, Onyenwe IW. Haematological profiles of pigs raised under intensive management system in south-eastern Nigeria. *Nig Vet J.* 2010;31:115-123. **https://doi.org/10.4314/nvj.v31i2.68958**

5. Perri AM, O'Sullivan TL, Harding JCS, Wood RD, Friendship RM. Hematology and biochemistry reference intervals for Ontario commercial nursing pigs close to the time of weaning. *Can Vet J.* 2017;58:371-376.

6. Ventrella D, Dondi F, Barone F, Serafini F, Elmi A, Giunti M, Romagnoli N, Forni M, Bacci ML. The biomedical piglet: Establishing reference intervals for haematology and clinical chemistry parameters of two age groups with and without iron supplementation. *BMC Vet Res.* 2017;13:23. **https://doi.org/10.1186/s12917-017-0946-2**

7. Sanchez NCB, Carroll JA, Corley JR, Broadway PR, Callaway TR. Changes in the hematological variables in pigs supplemented with yeast cell wall in response to a *Salmonella* challenge in weaned pigs. *Front Vet Sci.* 2019;6:1-13. **https://doi.org/10.3389/fvets.2019.00246**

8. Etim NN, Offiong EEA, Williams ME, Asuquo LE. Influence of nutrition on blood parameters of pigs. *Am J Biol Life Sci.* 2014;2(2):46-52.

9. Lee SH, Shinde PL, Choi JY, Kwon IK, Lee JK, Pak SI, Cho WT, Chae BJ. Effect of tannic acid supplementation on growth performance, blood hematology, iron status and faecal microflora in weanling pigs. *Livest Sci.* 2010;131:281-286. **https://doi.org/10.1016/j.livsci.2010.04.013**

10. Martins JM, Silva D, Albuquerque A, Neves J, Charneca R, Freitas A. Physical activity effects on blood parameters, growth, carcass, and meat and fat composition of Portuguese Alentejano pigs. *Animals (Basel).* 2021;11:156. **https://doi.org/10.3390/ani11010156**

11. Statistical Office of the Republic of Slovenia. Livestock number, 1. 12. 2021. Published February 11, 2022. Accessed March 1, 2024. **https://www.stat.si/StatWeb/en/news/Index/10139**

12. Batorek Lukač N, Tomažin U, Škrlep M, Kastelic A, Poklukar K, Čandek-Potokar M. Krškopoljski prašič [Krškopolje Pig]. In: Čandek-Potokar M, Nieto Linan R, eds. *European Local Pig Breeds - Diversity and Performance. A study of project TREASURE.* IntechOpen; 2019. Accessed March 15, 2024. **https://doi.org/10.5772/intechopen.83767**

13. Tomažin U, Mežan A, Kastelic A, Batorek-Lukač N, Škrlep M, Čandek-Potokar M. Rastnost pujskov krškopoljske pasme do konca vzreje [The growth of piglets of the Krškopolje breed until the end of breeding]. In: *Proceedings of the 24th International Scientific Symposium on Nutrition of Farm Animals.* Kmetijsko Gozdarska Zbornica Slovenije, Kmetijsko Gozdarski Zavod; 2015:8.

14. Mežan A, Kastelic A, Tomažin U, Čandek-Potokar M. Spremljanje rasti sesnih pujskov pasme krškopoljski prašič [Monitoring the growth of suckling piglets of the Krškopolje pig breed]. *Kmetovalec.* 2015;83:13-14.

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

16. R Core Team. R: A language and environment for statistical computing. R Foundation for Statistical Computing; 2013. Accessed January 12, 2024. **https://www.R-project.org**

17. Ammer T, Schützenmeister A, Prokosch H-U, Rauh M, Rank CM Zierk J. refineR: A novel algorithm for reference interval estimation from real-world data. *Sci Rep.* 2021;11:16023. **https://doi.org/10.1038/s41598-021-95301-2**

18. Klem TB, Bleken E, Morberg H, Thoresen SI, Framstad T. Hematologic and biochemical reference intervals for Norwegian crossbreed grower pigs. *Vet Clin Pathol.* 2010;39:221-226. **https://doi.org/10.1111/j.1939-165X.2009.00199.x**

19. Cooper CA, Moraes LE, Murray JD, Owens SD. Hematologic and biochemical reference intervals for specific pathogen free 6-week-old Hampshire-Yorkshire crossbred pigs. *J Anim Sci Biotechnol.* 2014;5:5. **https://doi.org/10.1186/2049-1891-5-5**

20. Jazbec I. Klinično laboratorijska diagnostika [Clinical laboratory diagnostics]. *Veterinarska fakulteta.* 1990:82-106.

21. Golinar Oven I, Nemec Svete A, Hajdinjak M, Plut J, Štukelj M. Haematological profiles of pigs of different age in relation to the presence or absence of porcine reproductive and respiratory virus, porcine circovirus type 2 and hepatitis E virus. *Ital J Anim Sci.* 2022;21(1):1287-1296. **https://doi.org/10.1080/1828051X.2022.2107954**

22. Evans EW. Interpretation of porcine leucocyte responses. In: Feldman BF, Zinkl JG, Jain NC, Schalm OW, eds. *Schalm's Veterinary Hematology.* 5th ed. Lippincott Williams and Wilkins; 2000:411-416.

23. Lindholm-Perry AK, Kuehn LA, Wells JE, Rempel LA, Chitko-McKown CG, Keel BN, Oliver WT. Hematology parameters as potential indicators of feed efficiency in pigs. *Transl Anim Sci.* 2021;5(4):txab219. **https://doi.org/10.1093/tas/txab219**

24. Zang J, Chen J, Tian J, Wang A, Liu H, Hu S, Che X, Ma Y, Wang J, Wang C, Du G, Ma X. Effects of magnesium on the performance of sows and their piglets. *J Anim Sci Biotechnol.* 2014;5(1):39. **https://doi.org/10.1186/2049-1891-5-39**

25. Eppenstein R. Improved concrete outdoor runs in housing systems for growing-finishing pigs: Temporary access to pasture. In: Eppenstein R, Thanner S, eds. *Welfare and Environmental Impact of Organic Pig Production. A Collection of Factsheets.* Research Institute of Organic Agriculture FiBL; 2022:29-31. Accessed March 20, 2024. **https://www.fibl.org/fileadmin/documents/shop/1300-hb-power-en.pdf**

Ergotism in an organic sow herd and the impact on lactation performance and subsequent reproductive performance

Katrina Senatra, Tara Gaab, Meghann Pierdon

Abstract

Ergot alkaloids (EA) are produced by fungi, including *Claviceps purpurea,* which can lead to EA contamination of wheat and cereal grains and cause sow agalactia by inhibiting prolactin production. In this case of sow agalactia and increased piglet mortality, a diagnosis of ergotism was made based on clinical signs and feed analysis. The lactation diet had EA at 330 ppb and was fed to sows for 12 to 14 days resulting in 79% (50%) mean (SD) mortality in exposed litters. Ergot alkaloid levels as low as 0.33 mg/kg of feed (0.33 ppm) may result in clinical signs in lactating sows.

Keywords: swine, ergot, mycotoxin, agalactia, organic production

Received: April 30, 2024
Accepted: September 14, 2024
Published online: January 16, 2025

Resumen -Ergotismo en un hato de producción orgánica de cerdas y su impacto en la producción de la lactancia y el rendimiento reproductivo subsecuente

Los alcaloides del cornezuelo de centeno (ergot; EA) son producidos por hongos, incluido el *Claviceps purpurea,* que pueden provocar la contaminación por EA de los granos de trigo y cereales, y causar agalactia en las cerdas al inhibir la producción de prolactina. En este caso de agalactia de cerdas y aumento de la mortalidad de lechones, se realizó un diagnóstico de ergotismo basado en los signos clínicos y el análisis del alimento. La dieta de lactancia contenía 330 ppb de EA y las cerdas lo consumieron entre 12 a 14 días, lo que causó una mortalidad media (DE) del 79% (50%) en las camadas expuestas. Niveles de alcaloides del cornezuelo de centeno tan bajos como 0.33 mg/kg de alimento (0.33 ppm) pueden producir signos clínicos en cerdas lactantes.

Résumé – Ergotisme dans un troupeau de truies écologique et l'impact sur les performance de lactation et les performances reproductrices subséquentes

Les alcaloïdes de l'ergot (AE) sont produits par des champignons, incluant *Claviceps purpurea*, et peuvent entraîner une contamination du blé et des grains céréaliers par les AE et causer de l'agalactie chez les truies en inhibant la production de prolactine. Dans le présent cas d'agalactie chez des truies et un taux de mortalité augmenté des porcelets, un diagnostic d'ergotisme a été posé sur la base des signes cliniques et de l'analyse des aliments. La moulée de lactation avait un taux d'AE de 300 ppb et a été donnée aux truies pendant 12 à 14 jours ce qui a résulté en une mortalité moyenne de 79% (SD = 50%) dans les portées exposées. Des niveaux d'alcaloïdes de l'ergot aussi bas que 0.33 mg/kg d'aliment (0.33 ppm) peuvent causer des signes cliniques chez les truies en lactation.

Claviceps species are types of fungi that may infect grasses and cereal grains (eg, rye, wheat, barley, and oats) during flowering by invading the plant ovary to produce sclerotia, or ergots, that replace the seed. The sclerotium is a life stage of the fungus that may produce various levels of mycotoxins called ergot alkaloids (EA). When the grains are harvested these ergots containing the toxic EA contaminate the final product. The type and quantity of EA produced by sclerotia can vary, but levels of EA are generally proportional to the quantity of sclerotia.

Canadian harvest sampling by the Canadian Grain Commission reported the highest incidence of EA in rye, then wheat, followed by barley and oats.[1] These EA act as noradrenaline, dopamine, and serotonin agonists with various toxic effects. In the lactating and periparturient sow, EA inhibit the secretion of prolactin by binding the lactotrophs in the pituitary and activating D_2 dopamine receptors. Vasoconstriction is caused by agonist activity that varies by vascular bed where the EA are alpha two receptor agonists that cause constriction, especially in peripheral arterioles.[2]

While ergotism is the earliest documented mycotoxicosis as a common cause of gangrene in people in the Middle Ages,[3] its relevance to animal agriculture may be increasing. Some data indicate that

KS, TG: Animal and food sciences, University of Delaware, Newark, Delaware.

MP: Department of Clinical Studies, New Bolton Center, University of Pennsylvania School of Veterinary Medicine, Kennett Square, Pennsylvania.

Corresponding author: Dr Meghann K. Pierdon, 382 West Street Rd, Kennett Square, PA 19348; Tel: 610-925-6203; Email: **mpierdon@vet.upenn.edu**

Senatra K, Gaab T, Pierdon M. Ergotism in an organic sow herd and the impact on lactation performance and subsequent reproductive performance. *J Swine Health Prod*. 2025;33(2):62-68. **https://doi.org/10.54846/jshap/1408**

the incidence of ergot in grains in western Canada is on the rise. For example, the detected incidence of EA in durum wheat samples from 1995 to 2009 was 2.9% compared to 13.1% from 2010 to 2022. However, the levels of EA detected in the samples remained similar across the two periods.[1] Levels of ergot may be influenced by farming methods and changing weather patterns associated with climate change, especially given that growing conditions for *Claviceps* species are favorable during flowering periods with extended moisture.[4] Organic farming, while not studied specifically, may predispose cereal grains to ergot contamination. Given that current varieties tend to generate lower yields under organic conditions, they may also have an altered response to fungal growth under such conditions.[5]

Most research on the impact of EA on sows is in an experimental setting and is constrained in duration and timing of feeding by ethical guidelines because of the predicted impact on piglet mortality due to starvation. There are few cases reported in the literature, with the documented cases occurring in different geographies where the fungal species and EA profile could vary compared to US herds.[6,7] Hence, documentation of cases is needed to generate more evidence for the impact on lactating sows. Because the evidence for the impact of differing EA levels in sows is limited, agencies like the European Food Safety Authority (EFSA) Panel on Contaminants in the Food Chain generated the 2022 reference point for EA levels in pig feed based on data primarily derived from growing swine. More information is needed, especially in lactating sows, to determine a no-observed-adverse-effect level (NOAEL).[8] Inconsistent recommendations come from the mismatch between controlled toxicology studies and the levels from field exposure reported to have an impact.[4] Further understanding of the risks of feeding EA contaminated small grains is needed to prevent toxic levels of exposure.

In this case report, we share the level of EA and duration of exposure found under field conditions in a herd that experienced a high neonatal mortality event consequent to agalactia in the sows. Our aims are to offer practical information for including EA toxicity on the differential list for veterinarians and offer suggestions on practical methods for prevention that should be discussed with feed suppliers.

Case description

Farm description

The affected farm was a 230-sow, farrow-to-feeder herd located in the eastern United States. The farm batch farrowed approximately 20 sows every other week and met the US Department of Agriculture's organic standards for swine production.[9] Every other Friday, typically 3 to 9 days prior to their farrowing date, sows were loaded into two farrowing rooms, each of which contained 10 individual farrowing pens with no farrowing crate. All diets were prepared by a commercial feed mill and developed by a swine nutritionist to meet NRC standards.[10] During gestation, the sows were fed an organic gestation diet. Once they entered the farrowing rooms, sows were fed an organic lactation diet. The sows were typically weaned 5 weeks later to meet the organic standard weaning age of at least 28 days (mean [SD] pig age was 34 [2.3] days at weaning). Room temperatures ranged from 12.6°C to 26.2°C during October 2022, the month of the outbreak.

Case presentation

The suspected contaminated feed delivery occurred on October 5, 2022 (Table 1). The first clinical sign reported on October 11, 2022 was loss of udder development in group 4, which were placed in the farrowing rooms on October 7 (Table 2). Udder development also did not occur in those sows after farrowing (Figure 1). In addition, caretakers noted loss of udder development resulting in piglets falling behind in group 3, which had farrowed 2 to 8 days prior to the feed delivery (Table 2). Group 2, which had been loaded into farrowing 26 days prior to feed delivery and had piglets that were 17 to 22 days old, did not show any clinical signs (Table 2). While feed intake was not recorded, farm staff reported that sows had decreased feed intake and increased feed refusal during this period. Piglets appeared agitated and were frequently seen at the udder trying to nurse. There was no report of piglet diarrhea.

The feed was switched to an alternate feed on October 19, 2022. This resulted in an exposure window of 12 to 14 days based on the feed delivery date, the onset of symptoms, and the replacement of the feed to the affected groups (Tables 1 and 2). Subsequently, farrowing groups 3 and 4 that were exposed to the contaminated feed either prior to farrowing or within 8 days of farrowing, experienced increased piglet mortality (Tables 3 and 4). No sows were fed the contaminated feed after the 14 days of exposure (Table 1).

Differential diagnoses

Given that primary agalactia was the clinical diagnosis, ergotism would be on the differential list. However, agalactia in sows could be related to other estrogenic factors such as zearalenone, bacterial infections of the mammary gland, or mastitis-metritis-agalactia syndrome.[11] Differentials for anorexia in sows would include other mycotoxins, such as Deoxynivalenol,[11] as well as other causes of systemic illness.

Production Effects

Production records were gathered for 6 farrowing groups: group 1 was weaned the day after delivery of the suspected contaminated feed; group 2 farrowed at least 17 days before delivery of the contaminated feed; group 3 farrowed 2 to 8 days before delivery of the contaminated feed; and group 4 consumed the contaminated feed for up to 10

Table 1: Timeline of feed delivery and diagnostic testing events from the delivery of the presumptive contaminated feed to the replacement of the contaminated feed

Event date	Day	Event
Wednesday, October 5, 2022	0	Organic lactation feed delivery
Tuesday, October 11, 2022	6	Clinical signs reported
Monday, October 17, 2022	12	Diagnostic samples taken
Wednesday, October 19, 2022	14	New feed to groups in farrowing
Monday, October 31, 2022	26	Contaminated feed removed
Tuesday, November 1, 2022	27	Feed analysis results back
Monday, November 7, 2022	33	Re-order organic feed

Table 2: Sow groups included in the case report

Farrowing group	No. of sows	Rooms	Loading date	First farrowing	Last farrowing	Wean date	Max exposure*, d	Pig age at feed delivery, d	Pig age at feed replacement†, d	Mortality, median (IQR), %
1	15	1, 6	8/26/22	8/31/22	9/6/22	10/6/22	1	29 to 35	Weaned	23.1 (17)
2	19	2, 3	9/9/22	9/13/22	9/18/22	10/20/22	14	17 to 22	31 to 36	17.6 (14)
3	20	4, 5	9/23/22	9/27/22	10/3/22	11/3/22	14	2 to 8	16 to 22	60.0 (37)
4	19	1, 6	10/7/22	10/11/22	10/17/22	11/17/22	12	-4 to -10	2 to 5	100.0 (11)
5	19	2, 3	10/21/22	10/23/22	10/31/22	12/1/22	0	Not in farrowing	Not in farrowing	13.3 (32)
6	19	4, 5	11/3/22	11/6/22	11/15/22	12/14/22	0	Not in farrowing	Not in farrowing	24.3 (26)

* The maximum exposure is the maximum number of days the sows could have consumed the feed delivered on October 5th which tested positive for ergot alkaloids.

† The pig age when the feed was replaced represents the range of ages for the piglets when the sows were fed a new feed that was not from the contaminated batch.

Figure 1: A) Normal udder development in a sow 24 hours prior to parturition that was not exposed to ergot alkaloid contaminated feed in contrast with **B)** poor mammary development in a sow after exposure to ergot alkaloid contaminated feed.

days prior to farrowing and 5 days after farrowing (Table 2). While group 2 consumed the contaminated feed for up to 14 days, there was no impact on mortality for that group (Table 2), so it was combined with groups 1, 5, and 6 to represent groups that had not been affected. None of the production variables were normally distributed and data were reported as medians and interquartile ranges (IQR). To look for differences between medians, a Mann Whitney U-test was done and $P < .05$ was treated as significant and $P < .10$ was considered a trend. The mortality data compared the percentages of each cause of death in groups 1, 2, 5, and 6 to affected litters in groups 3 and 4. The mortality for each litter was categorized on the farm as total mortality, low viability, laid on, starved, and euthanized. There was no difference in the percentage of piglets laid on ($P > .05$). However, there was a significant difference in the percentage of total mortality, as well as the percentages of low viability, starvation, and euthanasia in the exposed litters ($P < .001$; Table 3). The production data gathered on the litters included the number of liveborn, stillborn, and mummies, litter birth weight, and number weaned. There was no difference in the number of liveborn, stillborn, or mummies per litter ($P > .05$). There was a trend for lower birth weight in the exposed litters ($P = .06$) and a significant difference in the number of pigs weaned in the exposed litters ($P < .001$; Table 4).

The data collected on sow outcomes included the date of the next detected estrus, whether the next breeding was successful (ie, resulted in farrowing), removal from the herd before the next breeding, and the size of the next litter. None of the variables were normally distributed and were reported as median and IQR. Differences in medians were calculated using the Mann Whitney U-test. To look for a relationship between the categorical variables of exposure to ergot and farrowing or removal, the Fisher's Exact test was used. The wean-to-estrus interval was significantly shorter in groups 1, 2, 5, and 6 (5 [1] days) compared to the affected sows in groups 3 and 4 (8.5 [25.0] days; $P = .02$). The odds of successful breeding were not different in the affected sows (74.1% farrowed) compared to the unaffected sows (84.1% farrowed; $P = .38$). The odds of removal before next breeding were not different between affected sows (30.8% removed) and unaffected sows (17.3% removed; $P = .15$). The size of the next litter weaned was no different between the affected sows (12 [2.5]) and the unaffected sows (11 [3]; $P = .28$).

Table 3: Median and interquartile range (IQR) of mortality metrics for two groups of farrowing sows, one fed ergot alkaloid contaminated feed and one fed noncontaminated feed

	Groups 3 and 4*	Groups 1, 2, 5, and 6†	*P*
No. of litters	39	75	NA
Total mortality, median (IQR), %	79 (50)	20 (20)	< .001
Low viability, median (IQR), %	0 (21)	0 (0)	< .001
Laid on, median (IQR), %	7.7 (0.2)	8.3 (0.2)	.76
Starved, median (IQR), %	17.6 (29.4)	0 (0)	< .001
Euthanized, median (IQR), %	26.3 (21.0)	5.9 (13.3)	< .001

* Group 3 farrowed 2-8 days before delivery of the contaminated feed and group 4 consumed the feed for up to 10 days prior to farrowing and 5 days after farrowing.

† Group 1 was weaned the day after delivery of the suspected contaminated feed, group 2 farrowed at least 17 days before delivery of the contaminated feed, and groups 5 and 6 were never fed the contaminated feed.

Table 4: Median and interquartile range (IQR) of farrowing productivity metrics for two groups of farrowing sows, one fed ergot alkaloid contaminated feed and one fed noncontaminated feed

	Groups 3 and 4*	Groups 1, 2, 5, and 6†	*P*
Liveborn, median (IQR), No.	15.0 (5.0)	16.0 (4.0)	.39
Stillborn, median (IQR), No.	1 (1.0)	0 (1.0)	.17
Mummies, median (IQR), No.	0 (0)	0 (1.0)	.35
Birth weight, median (IQR), kg	18.4 (5.9)	19.8 (6.2)	.06
Weaned, median (IQR), No.	3 (8)	12 (3)	< .001

* Group 3 farrowed 2-8 days before delivery of the contaminated feed and group 4 consumed the feed for up to 10 days prior to farrowing and 5 days after farrowing.

† Group 1 was weaned the day after delivery of the suspected contaminated feed, group 2 farrowed at least 17 days before delivery of the contaminated feed, and groups 5 and 6 were never fed the contaminated feed.

Diagnostic test results

Fresh and formalin-fixed tissues from four 3-day-old (group 3) and four 2-week-old (group 4) piglets were submitted to the Iowa State University Veterinary Diagnostic Laboratory (ISU VDL; Ames, Iowa) on October 17, 2022. Tissues submitted included lung, heart, liver, kidney, spleen, small intestine, and colon. Oral fluids were collected from individual sows in groups 3 and 4 and pooled by group. Grossly, piglets of both ages were severely underweight and their stomachs empty, although there was some digesta in the cecum and spiral colon. Histopathology on the lung, heart, liver, kidney, spleen, intestine, and colon was unremarkable. Bacterial cultures on the 2-week-old pigs revealed moderate numbers of smooth *Clostridium perfringens* and low numbers of smooth mucoid *Escherichia coli* in the colon, and moderate numbers of smooth mucoid *E coli* in the intestine. Two pools of piglet feces, one for the 3-day-old pigs and one for the 2-week-old pigs tested negative by polymerase chain reaction (PCR) for rotavirus groups A and B and Sapovirus (cycle threshold [Ct] ≥ 37). The pool of feces from the 3-day-old piglets tested positive for rotavirus group C (Ct = 35.5). Oral fluids from both groups of sows tested negative by PCR for both North American and European Union porcine reproductive and respiratory syndrome virus strains (Ct ≥ 37) and for influenza A virus (Ct ≥ 38).

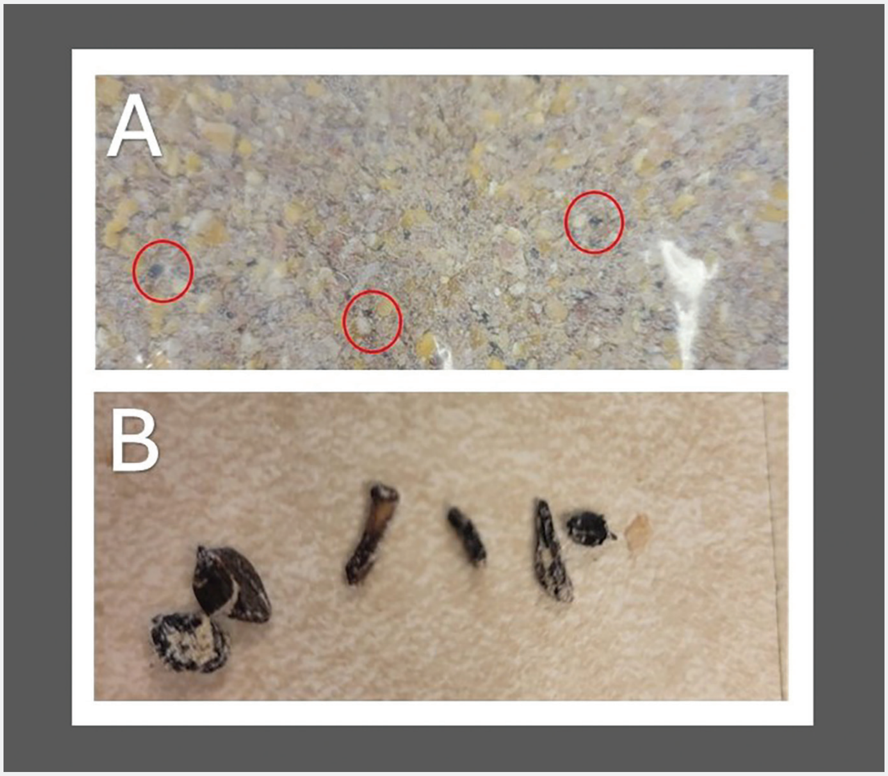
Feed analysis

Visual inspection of the lactation diet revealed black material consistent with, but not definitive for, the presence of fragmented ergot sclerotia (Figure 2). Complete feeds taken from the feed carts for the gestation and lactation diet were submitted to the ISU VDL analytical chemistry service for mycotoxin screening by liquid chromatography and tandem mass spectroscopy and an ergopeptine panel using high performance liquid chromatography (HPLC). The HPLC included the six main EA defined by EFSA: ergovaline, ergosine, ergotamine, ergocornine, ergocryptine, and ergocristine.[12] Ergovaline was 100 ppb and ergotamine was 230 ppb, for a total of 330 ppb, or 0.33 mg EA per kg of feed, in the lactation diet. However, EA was undetectable in the gestation diet (Table 5). Retained samples from the feed mill of the lactation diet mixed for this farm were tested at Trilogy Analytical Laboratory (Washington, Missouri) for five of the six EA, and none were detectable by HPLC (< 25 ppb; Table 5). It is unknown whether this retained sample was representative of the feed fed to the exposed groups at the farm. In discussions with the feed mill, it was revealed that the lactation feed did contain wheat despite its absence on the feed ticket ingredient list. The wheat was never tested for EA or visually examined or screened for the presence of ergot sclerotia. Deoxynivalenol was not found at levels consistent with anorexia in swine, 2 to 8 ppm (Table 5).[11] Neither Zearlenone nor α-Zearalenol were detectable in the samples (Table 5).

Diagnosis and treatment

Diagnosis of primary agalactia due to ergotism was based on findings of EA in the diet (Table 5) and absence of other pathogens or toxins to explain the acute rise in agalactia and piglet mortality. Removal of the contaminated feed also supported the diagnosis as groups 5 and 6 did not show an increase in mortality when the feed was changed (Table 2). However, changing the feed did not induce early lactating sows in the exposed groups to resume or commence milk production. Twenty-eight of thirty-nine litters in the exposed group were treated with First Formula (IMPRO products) at a dose of 1mL/pig. This oral liquid supplement containing whey solubles is approved for use as a nutritional supplement in organic herds and is intended to improve gut health but is not a substitution for caloric intake.

Figure 2: A) Feed containing ergot alkaloid. The presence of the black spots (red circles) is consistent with sclerotia. **B)** Presumptive pieces of ergot sclerotia that were sifted from the feed.



Discussion

Different species of *Claviceps* may have different clinical effects depending on the profile of EA production for the species. A controlled trial by Abdelrahim et al[13] found that *Claviceps africana* in sorghum fed to sows at 0, 11.75, and 23.5 mg of EA per kg of feed at two ill-defined periods showed no influence on lactation performance. This is in contradiction to all other studies. Kopinski et al[4] fed *C africana* contaminated sorghum at 16 mg EA per kg of feed to sows from 14 to 28 days post farrowing and saw decreased feed intake, even with the inclusion of flavoring, decreased serum prolactin in the sows, and decreased piglet weight gain. When *C africana* contaminated sorghum was fed from 1.4 to 7 mg EA per kg of feed to sows before farrowing, they found an impact on udder development and prolactin levels in all groups, especially parity one animals.[15] Though our sows were likely exposed to *Claviceps purpurea*, our results are consistent with those studies that showed a production impact of EAs from *C africana*.

Studies on *C purpurea* are rarer. The EFSA suggests feeding 0.6 mg EA per kg of feed or less is acceptable based on the available evidence, mainly in growing pigs, citing only four studies available in sows, including three that were published in 1945, 1972, and 1986 when EA quantification was done on a dry matter basis.[16-18] Our results with feeding EA at 0.33 mg EA per kg of feed, if representative of the concentration in the rest of the feed, were lower than those reported in the literature to cause agalactia for either *C purpurea* or *C africana*.

Though the levels of EA found in this case were lower than those reported previously, the clinical presentation was consistent with the literature in both field studies as well as controlled feeding trials. A 160-sow, farrow-to-finish herd in France was exposed to wheat containing *C purpurea* sclerotia resulting in 3.49 mg of EA per kg of feed for 10 to 15 days at the end of gestation and 8.05 mg of EA per kg of feed in lactation. This resulted in piglet mortality ranging from 23% to 100% of the litter in 13 of 20 sows fed the contaminated feed.[7] Kopinski et al[14] had 87% piglet mortality when sows were exposed to *C africana.* Blaney et al[6] documented multiple farms exposed to *C africana* and saw feed refusal and agalactia in sows resulting in piglet losses from a portion of the litter to the whole litter on all the farms examined. In this case, the group of sows fed contaminated feed after their piglets were at least 17 days of age (group 2), saw no difference in mortality from typical groups on this farm. Since 18 to 25 days of age is a typical weaning age, it may be that these sows did experience agalactia, but the piglets were able to cope with the decreased milk intake at that age.

These different species of *Claviceps* may contain different EA and therefore these comparisons should be interpreted accordingly. We found piglet mortality comparable to previous studies, although none of the other studies reported piglet mortality reasons.[6,7,14] When we analyzed the causes of piglet mortality, we saw a difference in piglet mortality reasons (low viability, starvation, and euthanasia) in groups where piglets were less than 8 days of age when exposure started, consistent sequelae to agalactia in the sows.

There were no clinical signs indicative of gangrene in any of the sow exposures documented in the literature, nor were there any in this case. Such signs may develop after long term exposure and are generally associated with exposure to EA for up to 3 months.[4] Conditions, such as cold temperatures that favor vasoconstriction,[2] would increase the likelihood of gangrene but would be unlikely to occur in traditional farrowing rooms in indoor housed sows. Such temperatures were not found in this study, room temperatures during the outbreak were within to slightly above the thermoneutral zone for sows (10°C-25°C).[19]

Evidence is mixed for the impact of EA on conception rate and has only been examined in a controlled setting where animals were exposed to *C africana*. Kopinski et al[14] saw decreased litter size in subsequent litters in sows exposed during lactation. In contrast, there was no difference in the number of corpus lutea or embryos in the gilts exposed to EA contaminated sorghum (0, 5, 10 mg/kg of feed) during the growing phase.[20] Consistent with that finding, we did not see an impact on the size of the subsequent litter or the likelihood of the next breeding resulting in a successful farrowing. We did find a prolonged wean-to-estrus interval. This longer interval could be due to the sows cycling while in the farrowing room because they were not nursing, and then were out of sync with the rest of the sow group. This could be exacerbated by batch farrowing systems where groups are not weaned weekly, as was done on this farm.

Table 5: Analytes in gestation and lactation feeds suspected of contamination during a piglet high-mortality event

Analyte	Gestation feed*	Lactation feed*	Retained lactation feed†	Retained gestation feed†
Ergovaline	NDA < 50	100 ppb	Not included	Not included
Ergosine	NDA < 50	NDA < 50	NDA < 25	NDA < 25
Ergotamine	NDA < 50	230 ppb	NDA < 25	NDA < 25
Ergocornine	NDA < 50	NDA < 50	NDA < 25	NDA < 25
Ergocryptine	NDA < 50	NDA < 50	NDA < 25	NDA < 25
Ergocristine	NDA < 50	NDA < 50	NDA < 25	NDA < 25
Aflatoxin B1	< 10 ppb	< 10 ppb		
Aflatoxin B2	< 10 ppb	< 10 ppb		
Aflatoxin G1	< 10 ppb	< 10 ppb		
Aflatoxin G2	< 10 ppb	< 10 ppb		
Deoxynivalenol	0.2 ppm	0.4 ppm		
3-Acetyl Deoxynivalenol	< 10 ppb	< 10 ppb		
Fumonisin B1	0.3 ppm	0.9 ppm		
Fumonisin B2	< 0.2 ppm	< 0.2 ppm		
Ochratoxin A	< 10 ppb	< 10 ppb		
T-2	< 10 ppb	< 10 ppb		
HT-2	< 10 ppb	< 10 ppb		
Zearalenone	< 0.2 ppm	< 0.2 ppm		
α-Zearalenol	< 200 ppb	< 200 ppb		

* Feed samples submitted by the farm were tested at the Iowa State University Analytical Chemistry Laboratory, Ames Iowa.

† Retained feed samples submitted by the feed mill were tested at the Trilogy Analytical Laboratory, Washington Missouri.

NDA = Nondetectable amount.

The only known treatment for EA toxicity is removal of the contaminated feed and replacement with a diet with EA below the NOAEL. In this case, the feed was replaced and symptoms did not occur in the following groups, but those sows with severe agalactia did not resume milk production and their litters suffered high mortality. There is little evidence in the literature for other treatments. Kopinski et al[14] attempted to cross foster piglets and use milk replacer in affected litters but piglet mortality was still 87%.[14] We treated piglets with a product containing whey solubles but this product is not meant to substitute caloric intake, thus we still saw 79% mortality. In Kopinski et al[15] they switched some sows that had received contaminated feed prefarrowing to the uncontaminated diet at farrowing and saw no detrimental impacts of EA on those litters, demonstrating a quick response to toxin removal prefarrowing. In this case, there were no groups that ate the contaminated feed and then had it removed prior to parturition. However, one study concluded that sows returned to normal milk production in 3 to 7 days after toxin removal, though this finding was not specific to the stage of lactation at which the sow was exposed.[11] This was inconsistent with the return to milk production observed in this case where sows exposed to EAs between 0 to 10 days prior to parturition and 2 to 22 days after farrowing showed no return to milk production. This could be due to the stage of lactation at which the sows were exposed, preventing udder development or redevelopment, or the lack of viable piglets remaining to stimulate a return to milk production.

Given the severity of EA impact, especially on periparturient and lactating sows, special consideration should be given to preventing EA contamination of diets fed to these animals. If cereal grains, such as rye, wheat, sorghum, barley, or oats, are included in a diet fed to sows before and during lactation, visual screening could be a low-cost way to prevent EA contamination. Coufal-Majewski et al[4] recommended counting and weighing the sclerotia after screening high-risk ingredients and that more than 5 sclerotia per liter of grain or 0.1% to 0.3% of grain on a dry matter basis is enough contamination that it should not be fed to pregnant or lactating animals. Based on the low levels found in this case, finding sclerotia or suspected sclerotia would warrant further testing using HPLC to test the EA concentration in the ingredient before its inclusion in a sow lactation diet.

If such ingredients are going to be fed to lactating sows, screening or physical removal can be effective but may be challenging if sclerotia are broken and therefore of similar size to the grains.[10] This is more likely if grain byproducts are being used, which could result in more broken sclerotia. Chemical binders exist for Deoxynivalenol and other mycotoxins, but more testing is needed to determine their effectiveness for EA.[4] Likewise, Mainka et al[21] indicated that steam treatment reduced total EA in the feed, but this has not been tested in the field to determine how to implement this technique at varying levels of contamination. Current information would suggest that the safest response to EA contamination of a feedstuff is to avoid feeding it to periparturient or lactating sows and to feed with caution to growing swine using the EFSA guidelines or other science-based recommendations.

More research is needed to determine the safe level of EA that lactating sows can tolerate as this case report is one of 2 in the literature that uses modern testing methodologies, documents field exposure to *C purpurea* in wheat, and reports the duration of exposure and the concentration of six common EA. Research into how organic production practices influence the likelihood of cereal grain inclusion in the diet and whether organic crop farming increases the chances for EA contamination of such grains is needed so there is a clear understanding of when the EA contamination risk is elevated. Though this farm is small and uses organic production practices, this case should be considered by practitioners when extreme agalactia resulting in high piglet losses is noted in any sow farm where the diet includes cereal grains. The feed mill should be queried about the inclusion of such ingredients as it may not be listed on the feed label. If EA contamination is suspected, multiple feed samples should be gathered from the farm, inspected visually for sclerotia, and sent for EA testing and quantification.

Implications

Under the conditions of this study:

- Severe agalactia resulted from feeding EA at .33mg/kg for 12 to 14 days.
- Lactating sow diets containing wheat should be screened for sclerotia.
- Determination of the NOAEL for EA in sows is needed.

Acknowledgments

The authors acknowledge the cooperation of the farm and the information shared from the feed mill.

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. Walkowiak S, Taylor D, Fu BX, Drul D, Pleskach K, Tittlemier SA. Ergot in Canadian cereals – relevance, occurrence, and current status. *Can J Plant Pathol.* 2022;44(6):793-805. **https://doi.org/10.1080/07060661.2022.2077451**

2. Gupta RC, Evans TJ, Nicholson SS. Ergot and Fescue Toxicoses. In: Gupta RC ed. *Veterinary Toxicology*. 3rd ed. Academic Press; 2018:995-1001. Accessed April 12, 2024. **https://doi.org/10.1016/B978-0-12-811410-0.00070-2**

3. Council for Agricultural Science and Technology. Task Force Report No. 139 Mycotoxins: Risks in plant, animal, and human systems. 2003. Accessed April 12, 2024. **https://www.cast-science.org/publication/mycotoxins-risks-in-plant-animal-and-human-systems**

4. Coufal-Majewski S, Stanford K, McAllister T, Blakley B, McKinnon J, Chaves AV, Wang Y. Impacts of cereal ergot in food animal production. *Front Vet Sci.* 2016;25:3-15. **https://doi.org/10.3389/fvets.2016.00015**

5. Rempelos L, Wang J, Sufar EK, Almuayrifi MSB, Knutt D, Leifert H, Leifert A, Wilkinson A, Shotton P, Hasanaliyeva G, Bilsborrow P, Wilcockson S, Volakakis N, Markellou E, Zhao B, Jones S, Iverson PO, Leifert C. Breeding bread-making wheat varieties for organic farming systems: The need to target productivity, robustness, resource use efficiency and grain quality traits. *Foods*. 2023;12(6):1209. **https://doi.org/10.3390/foods12061209**

6. Blaney BJ, McKenzie RA, Walters JR, Taylor LF, Bewg WS, Ryley MJ, Maryam R. Sorghum ergot (*Claviceps africana*) associated with agalactia and feed refusal in pigs and dairy cattle. *Aust Vet J.* 2000;78(2):102-107. **https://doi.org/10.1111/j.1751-0813.2000.tb10535.x**

7. Waret-Szkuta A, Larraillet L, Oswald IP, Legrand X, Guerre P, Martineau G-P. Unusual acute neonatal mortality and sow agalactia linked with ergot alkaloid contamination of feed. *Porcine Health Manag.* 2019;5:1-5. **https://doi.org/10.1186/s40813-019-0131-z**

8. EFSA Panel on Contaminants in the Food Chain. Risks for animal health related to the presence of ergot alkaloids in feed. *EFSA J.* 2024;22(1):e8496. **https://doi.org/10.2903/j.efsa.2024.8496**

9. United States Department of Agriculture Agricultural Marketing Service National Organic Program. Organic Livestock and Poultry Standards. 2023. Accessed April 12, 2024. **https://www.federalregister.gov/documents/2023/11/02/2023-23726/national-organic-program-nop-organic-livestock-and-poultry-standards**

10. Southern LL, Adeola O, De Lange CFM, Hill GM, Kerr BJ, Lindeman MD, Miller PS, Odle J, Stein HH, Trottier NL eds. *Nutrient Requirements of Swine*. 11th ed. National Research Council. 2012. Accessed April 12, 2024. **https://nap.nationalacademies.org/read/13298/chapter/1**

11. Ensley SM, Radke SL. Mycotoxins in Grains and Feeds. In: Zimmerman JJ, Karriker LA, Ramirez A, Schwartz KJ, Stevenson GW, Zhang J, eds. *Diseases of Swine*. 11th ed. John Wiley & Sons, Inc; 2019:1055-1071. **https://doi.org/10.1002/9781119350927.ch69**

12. Krska R, Crews C. Significance, chemistry and determination of ergot alkaloids: A review. *Food Addit Contam A Chem Anal Control Expo Risk Assess*. 2008;25(6):722-731. **https://doi.org/10.1080/02652030701765756**

13. Abdelrahim GM, Richardson RC, Gueye A. Impact of ergot infested sorghum on the reproductive performance of sows. *J Anim Res Technol*. 2012;1(1):1-6. **https://doi.org/10.5147/jart.v1i1.102**

14. Kopinski JS, Blaney BJ, Murray S-A, Downing JA. Effect of feeding sorghum ergot (*Claviceps africana*) to sows during mid-lactation on plasma prolactin and litter performance. *J Anim Physiol Anim Nutr (Berl)*. 2008;92(5):554-561. **https://doi.org/10.1111/j.1439-0396.2007.00747.x**

15. Kopinski JS, Blaney BJ, Downing JA, McVeigh JF, Murray S-A. Feeding sorghum ergot (*Claviceps africana*) to sows before farrowing inhibits milk production. *Aust Vet J*. 2007;85(5):169-176. **https://doi.org/10.1111/j.1751-0813.2007.00139.x**

16. Nordskog AW, Clark RT. Ergotism in pregnant sows, female rats and guinea pigs. *Am J Vet Res.* 1945;8:107-116.

17. Campbell CW, Burfening PJ. Effects of ergot on reproductive performance in mice and gilts. *Can J Anim Sci*. 1972;52(3):567-569. **https://doi.org/10.4141/cjas72-068**

18. Dignean MA, Schiefer HB, Blair R. Effects of feeding ergot-contaminated grain to pregnant and nursing sows. *Zentralbl Veterinarmed A*. 1986;33(10):757-766. **https://doi.org/10.1111/j.1439-0442.1986.tb00588.x**

19. Hill G, Lay Jr DC, Richert B. Swine. In: Tucker CB, MacNeil MD, Webster AB, eds. *Guide for the Care and Use of Agricultural Animals in Research and Teaching*. 4th ed. Federation of Animal Science Societies; 2020:291.

20. Kopinski JS, Blaney BJ, Downing JA. Tolerance of pigs to sorghum ergot (*Claviceps africana*) during growth and finishing, and effect on conception of replacement gilts. *Aust J Exp Agric*. 2008;48(5):672-679. **https://doi.org/10.1071/EA07326**

21. Mainka S, Dänicke S, Ueberschär K-H, V Reichenbach HG. Effect of a hydrothermal treatment on ergot alkaloid content in ergot contaminated rye. *Mycotoxin Res*. 2005;21:116-119. **https://doi.org/10.1007/BF02954433**

Pork Checkoff engages science to grow demand

Pork producers and their herd veterinarians rely on science and research results to make sound business and swine health decisions. The Pork Checkoff plays a key role in this process, providing data from research, equipping producers and veterinarians with guidance for enhancing performance, improving pork quality, and, whenever possible, fueling profitability.

The same reliance producers and veterinarians have on data extends beyond production to an equally essential function of the Pork Checkoff, growing demand. That is where National Pork Board's (NPB) Consumer Connect research comes in. "This research helps us learn even more about our core consumers, delivering new and updated insights on how different segments prioritize different needs," said Dr David Newman, senior vice president, market growth, National Pork Board. "For example, we know consumers make choices about food based on taste, nutrition, and convenience; we can help them develop a preference for pork by showing them that it can meet the needs they find most important in their own lives."

The US Department of Agriculture (USDA) Economic Research Service data from 2023 shows per capita consumption of pork totaled 50.2 pounds.[1] However, not each of the 334.9 million US residents consumed that amount of pork. The NPB's Consumer Connect research helps shed light on who is, and is not, eating pork and informs a new way to drive pork growth by understanding consumer needs.

The research revealed 7 distinct consumer segments defined by their motivations, needs, and emotions. Of these 7 segments, Confident Meat Eaters, Simple Feeders, Culinary Adventurers, and Mindful Choicemakers were identified as priority segments and Tasty Value Seekers, Culture Celebrators, and Meat Minimizers were identified as secondary segments. Definitions of each segment are available on the Pork Checkoff website (**porkcheckoff.org/pork-branding/consumer-connect**), which also includes a quiz to help you identify the type of consumer you are (**segment.porkcheckoff.org**). Using the science, NPB will focus on what is important to these consumers, to improve its approach to positioning, activation, and measurement in the marketplace – ultimately making pork more relevant and generating long-term, sustainable demand.

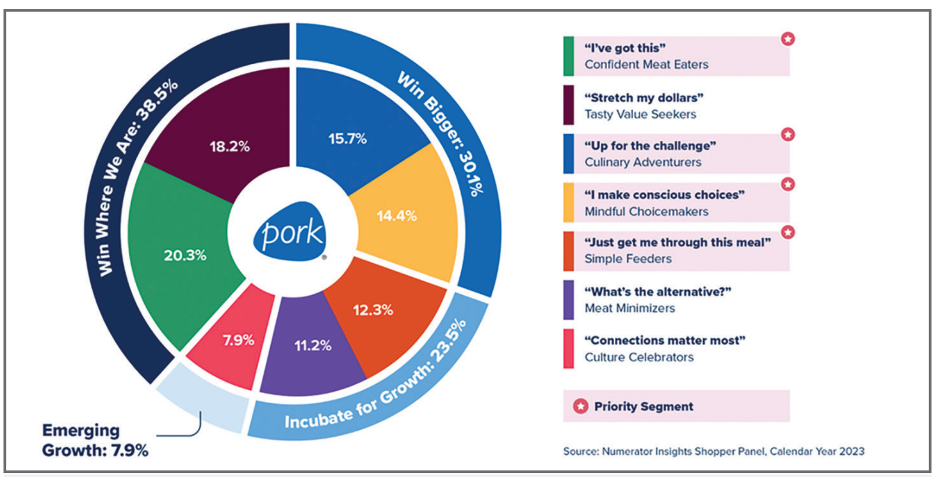
The quality of research data is reinforced by replication and validation. Consumer Connect data was evaluated by Dr Glynn Tonsor, professor, Department of Agricultural Economics at Kansas State University. Dr Tonsor leads the Meat Demand Monitor (MDM), a project tracking US consumer demand, perceptions, and preferences for meat that is jointly funded by the Pork and Beef Checkoff programs.

The MDM surveys over 3000 people each month to analyze consumer consumption, demand, and preferences of meat in both the retail and food service channels. As a testament to impact and broad interest in the MDM, Dr Tonsor regularly shares the latest MDM insights at key industry events including World Pork Expo, Annual Meat Conference, and USDA's Agricultural Outlook Forum.

"I often say you can only manage what you measure. Whether we are talking sow pregnancy rates, barrow feed efficiency, pork chop consumption, or willingness to pay for bacon, we can only improve the hog-pork industry by careful measurement to guide strategic decisions. The MDM is intentionally designed to aid with pork consumption and demand issues," Dr Tonsor said.

During the October 30, 2024 Global Hog Industry Conference, Dr Tonsor said MDM validated NPB's consumer segmentation research (Consumer Connect). He noted the relative size and composition (gender, income, pork consumption, etc) was very consistent between two independent data sources and analyses. The MDM research encompassed input from more than 21,000 respondents from March through September 2024.

The MDM team looked in greater detail at the segments defined by Consumer Connect among its respondents, offering additional insights to NPB for implementation in its new consumer marketing campaign launching in 2025. For instance, the MDM 2024 assessment revealed greater distinction across consumer segments in retail than food service demand highlighting that market channel specific plans hold merit. The full MDM report is available via AgManager.info along with all MDM project resources.[2]



National Pork Board Consumer Connect market segmentation data illustrates highest priority audiences, secondary targets, and growth opportunities for pork demand.

NPB news continued on page 71

Superior Science. Smart Solutions.

"I have been using Endovac-Porci in customer vaccine protocols for various gram-negative disease prevention since 2018. I have seen good success with Endovac in gilts, sows and the grow/finish pig. I would see my customers' use of Endovac continuing to expand based on the success we've had."

— DR. BRIAN SCHANTZ, OWNER OF DIVERSIFIED MANAGEMENT COMPANY

To learn how you can protect your operation while boosting immunity, visit EndovacAnimalHealth.com

Endovac
ANIMAL HEALTH

EndovacAnimalHealth.com

NPB news continued from page 69

"The MDM was launched to provide unbiased tracking of domestic meat consumption, demand, and preferences with a goal of enhancing decision-making by those in the US meat-livestock industry. The latest application of rich MDM data to verify and extend NPB's consumer segmentation research is an excellent example of the MDM delivering on its goal," Dr Tonsor said.

Measurement of economic and marketing results are central to NPB's mission to grow pork demand in a targeted, informed manner. Being able to verify and measure results will signal a positive return on investment. "The world increasingly is characterized by more data than was previously available. Said data only has value when it is applied to improve decisions. In this situation, the MDM is a relatively new data resource that not only is unique in richness but increasingly delivers on its goal of improving decisions following unique insights from ongoing data collection and assessment," Dr Tonsor said. "As the world continues to evolve, projects such as the MDM can help industry keep pace and hopefully by extension improve economic viability of industry participants."

Application of consumer demand science will culminate in an upcoming targeted outreach effort. "The most exciting piece of this process is what's coming in 2025. It's time to take our research and turn it into action for the pork industry, protecting our long-term position with consumers," Dr Newman said. "Working with industry partners, we are developing our biggest consumer outreach campaign in 25 years! This bold new approach, which is being introduced to the industry in March 2025, is about leveraging our long-term position and building support within the entire pork value chain."

References

1. US Department of Agriculture Economic Research Service. Livestock and Meat Domestic Data - meat supply and disappearance tables, recent. Updated December 31, 2024. Accessed January 13, 2025. **ers.usda.gov/sites/default/files/_laserfiche/DataFiles/104360/MeatSDRecent.xlsx?v=34014**

2. Tonsor G. Meat Demand Monitor: A Deep Look at US Consumer Segments. November 19, 2024. Accessed January 13, 2025. **agmanager.info/livestock-meat/meat-demand/monthly-meat-demand-monitor-survey-data/meat-demand-monitor-deep-look-us**

Alternate Student Delegate selected for AASV Board

The AASV Student Engagement Committee is pleased to announce the selection of Molly Jones, a second-year veterinary student at North Carolina State University (NCSU), as the incoming alternate student delegate to the AASV Board of Directors.

As described by her faculty advisor, Molly has dedicated her career to gaining considerable experience in swine production. During the academic year, she worked at the NCSU swine farm. During the summer months, she participated in internships in swine production, research, and medicine. Molly presented her research at the 2024 AASV Annual Meeting, and she will do so again during the 2025 AASV Annual Meeting in San Francisco.

During her undergraduate education, Molly was active in the Animal Science Club, where she led the club in multiple officer positions and organized events that connected students with industry professionals. Recognized as a rising star in the NCSU student AASV chapter, she is an active member and the current wet lab coordinator. In her upcoming role, Molly hopes to foster engagement and strengthen connections among veterinary students and the AASV.

Molly will assume her duties as the alternate student delegate during the 2025 AASV Annual Meeting. The current alternate delegate, Mallory Wilhelm (Iowa State University, 2026), will assume the delegate position currently held by Alexis Berte (Iowa State University, 2025), who will rotate off the board. Mallory and Molly will represent student interests within AASV as nonvoting members of the Board of Directors and the Student Engagement Committee. Please join us in welcoming Molly to the AASV Board of Directors and thanking Alexis for her service!

Molly Jones

AASV Swine Health Speaker Bank sign up

Are you interested in speaking to veterinary students and pre-veterinary students about swine medicine related topics? Would you be willing to volunteer your time to teach the next generation of veterinarians about what swine veterinarians do?

The AASV Communications Committee is inviting members who are willing and able to accept public speaking engagements on swine health and production topics to become part of a members-only, open-access speaker bank. This initiative is intended to help those seeking swine veterinarian speakers for their events (eg, academic lectures, student events, conferences, etc) to identify and reach out to potential speakers more easily. Members from all disciplines, backgrounds, locations, levels of training, and career stages are welcome to sign up. The list of speakers will be located on the AASV website as a members-only benefit under the student member benefits section (password required to access) and shared with AASV student chapters and faculty contacts at veterinary schools.

Those willing to be listed as potential speakers for various engagements (virtually or in person) are asked to complete a short form at **forms.gle/pEX58CTXvqXhDQHV9** to submit their name, contact information, states in which they are willing to speak, presentation languages, and any other preferences or specifics they would like to include in the list.

Please contact Dr Melissa Billing (**melissa.billing@boehringer-ingelheim.com**) with any questions.

Aspirin and sodium salicylate use in swine – webinar and audio recording available

During the November 20, 2024 Swine Health Information Center and AASV webinar, Dr Locke Karriker, AASV president-elect, provided an update on aspirin and sodium salicylate use in swine from a US regulatory perspective.

Dr Karriker's presentation can be viewed and the mp3 audio file can be downloaded from **aasv.org/advocacy/aspirin/**.

Previously, the US Food and Drug Administration (FDA) stated that aspirin use was of low regulatory concern. However, due to increased use of aspirin in H5N1-affected dairy cattle, FDA has expressed that this is no longer the case.

On October 11, 2024, the FDA issued a "Dear Veterinarian" letter clarifying that there are no FDA-approved aspirin products for use in cattle or other livestock. **The extra-label use of unapproved drugs in food-producing species is prohibited.**

In his presentation, Dr Karriker describes how this announcement affects swine and the pathways to legal use of drugs in swine. **There is no legal pathway to use aspirin, acetylsalicylic acid, or sodium salicylate in swine.**

Under the Animal Medicinal Drug Use Clarification Act (AMDUCA), veterinarians may use only FDA-approved human or animal drugs in food-producing species under specific conditions in an extra-label manner. **The extra-label use of unapproved drugs in food-producing species is prohibited.**

All FDA-approved animal products are required to carry one of the following statements on the label: "Approved by FDA under NADA # XXX-XXX" for brand name animal drugs or "Approved by FDA under ANADA # XXX-XXX" for generic animal drugs.

For more information, visit **aasv.org/advocacy/aspirin/**.

H5N1 influenza risk to US swine – webinar recording available

The Swine Health Information Center (SHIC), in collaboration with the American Association of Swine Veterinarians, hosted a webinar on H5N1 influenza risk to US swine on November 20, 2024. The goal of the webinar was to provide current information on H5N1 in livestock, including updates on the H5N1 outbreak in dairy cattle, the first detection of H5N1 in a pig on a small backyard farm in Oregon, research on H5N1 in swine, and a literature review covering gaps in knowledge for H5N1.

The webinar can be accessed at **aasv.org/video/shic-webinars/**.

Webinars sponsored by SHIC and AASV bring together subject matter experts to discuss current issues facing US pork producers and practitioners. Conducted by the Iowa State University Swine Medicine Education Center, webinar participants include practitioners with first-hand experience with the topic being discussed, diagnosticians, and other experts. Recorded webinars from 2019 through 2024 are available in the video library.

Do you have a recommendation for a topic to be addressed in this format? SHIC and AASV would like your input! Reach out to SHIC Executive Director Dr Megan Niederwerder at **mniederwerder@swinehealth.org** or AASV Director of Public Health and Communications Dr Abbey Canon at **canon@aasv.org** with your webinar recommendations.

AASV meeting proceedings available online

The proceedings of the AASV Annual Meeting continue to be a valued benefit for AASV members. All AASV members may access ALL of the conference papers, including those for the preconference seminars, regardless of whether they attend the meeting.

The papers for the 2025 AASV Annual Meeting – more than 230 - are now available for members to access at **aasv.org/proceedings/**.

Current (2025) dues-paid membership and an updated password for AASV's new website are required to access the files.

As in the past, the papers are available as follows:

- The "big book" of all the regular session papers in a single PDF file with a linked table of contents
- Seminar booklets: a PDF collection of papers for each preconference seminar
- A PDF file for each individual presentation is available in the Swine Information Library: **aasv.org/swine-information/**

Two Acosta Scholars receive meeting attendance stipends

The AASV Foundation has awarded two $2500 stipends to veterinary students in Mexico to facilitate their attendance at the 2025 AASV Annual Meeting in San Francisco, California. The recipients, Yaneli Hernández Flores, a student of Centro Universitario del Sur, and José de Jesús González Franco, a student of Centro Universitario de los Altos, were selected by the Martha Acosta Foundation, a nonprofit organization that supports the veterinary education of students in Latin America.

Dr Acosta, a longtime AASV member, will accompany Yaneli and Jose to the meeting where they will be introduced during the AASV-AASV Foundation Luncheon on Monday, March 3. The two recipients are current AASV student members. Yaneli will be participating in the student poster session in San Francisco on Sunday, March 2.

Following the meeting, they will write and submit a report on how the meeting and their membership in AASV has impacted their educational goals and career direction. José received the scholarship to attend the 2024 AASV Annual Meeting. Read more about his experience at **marthaacostafoundation.org/en/my-experience-as-a-mafi-scholar-during-the-aasv-2024-congress-2**.

The AASV Foundation's goal in providing the stipends is to promote swine veterinary medicine and encourage increased international student membership in AASV.

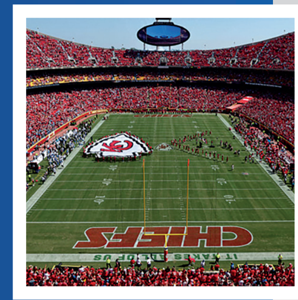
José de Jesús González Franco

Yaneli Hernández Flores

AASV Foundation Fundraising Auction

Prospecting for the Foundation

March 3, 2025
San Francisco, California



SILENT AUCTION

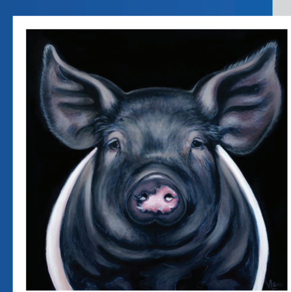
Bidding closes
Monday, March 3 at 7:00 PM PST

LIVE AUCTION

Monday, March 3
Immediately following the
AASV Awards Reception

View ALL items and
START BIDDING:

aasvf.cbo.io



Items will be shipped directly to the winning bidder by the donor.

Contact the AASV Foundation (foundation@aasv.org) to arrange for remote bidding in the live auction.

Auction Item Donors

ARKO Laboratories
Paul Armbrecht
Aurora Pharmaceutical
Joaquín Becerril
Bill Beckman
Melissa Billing
Boehringer Ingelheim
Cambridge Technologies
Cargill Animal Nutrition
Dyneah Classen
Kimberly Crawford
Alejandrina Da Silva De Pita
Susan Detmer
DNA Genetics
Fairmont Veterinary Clinic
Four Star Veterinary Service
Genesis Instruments
Christa Goodell
Hank and Isabel Harris
Megan Hood
Grace Houston
Huvepharma
Indiana Packers Corporation
Iowa State University Faculty
Iowa State University Veterinary Diagnostic Lab
Micah Jansen
Clayton Johnson
Kemin Animal Nutrition and Health
Andrew Kleis
John and Jill Kolb
Kuster Research and Consulting
Longhorn Vaccines and Diagnostics, LLC
Aaron Lower
MWI
National Pork Producers Council
Norbrook
Chris Olsen
Pharmacosmos
Pharmgate Animal Health
Phibro Animal Health Corporation
PigCHAMP
Preferred Capital Management
Karen Richardson
Larry Rueff
Lee Schulteis
Smithfield Foods
Suidae Health and Production
Sabrina Swenson
Swine Vet Center
Sherrie Webb
Brandon Whitt

Cash Donations

$5000 and above

AMVC
Paul J. Armbrecht
PIC USA

$2000 - $4999

Butch and Emma Baker
Innovative Veterinary Solutions
Zoetis

$1000 - $1999

Anonymous
Jack and Carla Coleman
Larry Coleman
Joe Connor
Wayne and Karen Freese
Peggy Anne Hawkins
Steve Henry
Mary Lou Chapek Hogg
J. Tyler Holck and Gayle Brown
Jim and Erin Lowe
Alex Ramirez
Cameron and Cassie Schmitt
Bob Thompson
The Waddell Family
Nathan Winkelman
Teddi Wolff

$500 - $999

Boyle Capital
Keith Kinsley
Hans Rotto
Struve Labs International
Swine Vet Center
Dr and Mrs Warren Wilson
Vincil Wilt
Barry Wiseman

$50 - $499

Pat Anderson
John Baker Family
Phil Gauger
Harold Tilstra

THANK YOU for your generous donations!

American Association Swine Veterinarians Foundation

FASTER. STRONGER. CLEANER.

Easy to apply

Excellent foaming capabilities

Quick disinfection

5-minute contact time

Efficacious

Superior kill performance against ASFv, PRRSv, PEDv, FMDv, TGE, SARS-CoV-2, and more.

5 Gallon Eco-Container

1 Gallon Bottle

55 Gallon Drum

Intervention® Concentrate Disinfectants cleans while it disinfects, and disinfects while it cleans. It provides the right balance between strength and responsibility: the power to kill pathogens while being gentle to humans, animals and equipment.

Make Intervention® Concentrate part of your disinfection routine.

InterventionDisinfectants.com

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

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

*See labels and reference sheets for a complete list of efficacy claims, contact times, additional features and directions for use.

DISCLAIMER: You must read and follow the instructions on the label for our product and use the product for the particular applications specified on the product label. To the full extent permitted under applicable law, Virox Technologies Inc. shall not be liable for any damages whatsoever, arising out of or otherwise in connection with any failure to follow those instructions or any use of its products which is not specified on the product's label. The instructions on the product label are not a warranty, express or implied, and Virox Technologies, Inc. expressly disclaims any implied warranties, including any warranty of fitness for a particular purpose. Under applicable law, some of the above waivers or disclaimers of warranty, or exclusions of liability for certain types of damages may not apply to you. In such cases, our liability will be limited to the fullest extent permitted by applicable law.

UPCOMING MEETINGS

56th Annual Meeting of the American Association of Swine Veterinarians
March 1-4, 2025 (Sat-Tue)
San Francisco Marriott Marquis
San Francisco, California

For more information:
Tel: 515-465-5255
Email: **aasv@aasv.org**
Web: **aasv.org/annmtg**

Animal Ag Alliance Stakeholders Summit
April 30 - May 2, 2025 (Wed-Fri)
Arlington, Virginia

For more information:
Web: **animalagalliance.org/initiatives/stakeholders-summit**

World Pork Expo
June 4-5, 2025 (Wed-Thu)
Iowa State Fairgrounds
Des Moines, Iowa

For more information:
Web: **worldpork.org**

ISU James D. McKean Swine Disease Conference
June 24-25, 2025 (Tue-Wed)
Gateway Hotel and Conference Center
Ames, Iowa

For more information:
Web: **regcytes.extension.iastate.edu/swinedisease**

AVMA Convention 2025
July 18-22, 2025 (Fri-Tue)
Washington, DC

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

Allen D. Leman Swine Conference
September 20-23, 2025 (Sat-Tue)
Saint Paul River Centre
Saint Paul, Minnesota

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

15th SAFEPORK–International Symposium on the Epidemiology and Control of Biological, Chemical and Physical Hazards in Pigs and Pork
October 6-8, 2025 (Mon-Wed)
Rennes, France

For more information:
Tel: +33 07 62 53 33 96
Email: **safepork@ifip.asso.fr**
Web: **safepork.ifip.asso.fr**

14th Leman China Swine Conference & World Swine Industry Expo
October 18-20, 2025 (Sat-Mon)
Changsha International Convention and Exhibition Center
Changsha City, Hunan Province, China

For more information:
Andy Zhang
Tel: +86 010 60600195
Cell: +86 137 18913262
Email: **andyzhang@shixin-expo.com**
Web: **lemanchina.com**

129th Annual Meeting of the US Animal Health Association
October 3 - November 5, 2025 (Thu-Wed)
Gaylord Rockies Hotel
Denver, Colorado

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

International Conference on Pig Livability
November 5-6, 2025 (Wed-Thu)
Hilton Omaha
Omaha, Nebraska

For more information:
Web: **piglivability.org/2025-conference**

AVMA Veterinary Leadership Conference
January 8-10, 2026 (Thu-Sat)
Chicago, Illinois

For more information:
Web: **avma.org/events/veterinary-leadership-conference**

28th Congress of the International Pig Veterinary Society
June 16-19, 2026 (Tue-Fri)
Nong Lam University HCMC
Ho Chi Minh City, Vietnam

For more information:
Web: **ipvs2026.vn**

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

JSHAP Resources

AASV resources __________ aasv.org

Author guidelines __________ aasv.org/author-guidelines

Journal of Swine Health and Production __________ aasv.org/jshap

Membership information __________ aasv.org/membership

Subscription information __________ ecom.aasv.org/journal

Upcoming meetings __________ aasv.org/meetings

Industry Support Council member info __________ aasv.org/advertising