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Gilt exposure to *Mycoplasma hyopneumoniae* through nebulization

Figueras S, Fano E, Alegre A, et al

Clinical hyperestrogenism associated with unintentional phytoestrogenic soybean intake

Timmer J, Holden D, Scott PC, et al

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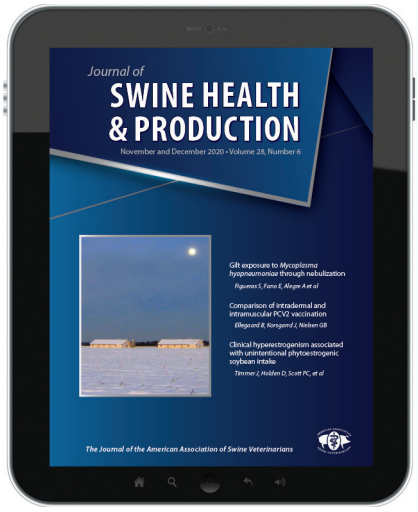

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quoted from Executive Director's Message, page 291

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Dispelling myths and sharing your passion

I love eating pork, maybe that is why I eagerly attended one of the early National Pork Board's Operation Main Street (OMS) training sessions some 15 years ago. The benefit of this program from my perspective was it would allow me to share my passion for pork with people outside my normal circle of friends. I am sure that many other AASV members who are OMS presenters feel the same way. Most of the presenters for OMS are pork producers, those of us who are also veterinarians are in a unique position to provide a slightly different perspective. As veterinarians who visit many different types of farms and production methods, we can assure consumers that the wide variety of producers are all doing their best to produce a safe and wholesome product.

Antibiotic use is an area that veterinarians can really help consumers understand the necessity of antibiotic use while reinforcing that they are only used when necessary. It may seem like common sense to us that treating a pig with antibiotics might actually improve the pork quality by treating the disease that could result in poor meat quality.

A key part of any OMS presentation is dispelling myths about modern pork production that our opponents broadcast freely on the internet. When I am speaking to a group in person, I always point out that I would not stand in front of a group and make statements that I do not believe myself to be true. This in-person connection should not be overlooked because I believe it is as important as the message. Improvements in sustainability through efficiency in swine production over the last 50 years give consumers confidence that they are not ruining the environment by eating pork. Less land use, less water use, and a smaller carbon footprint all together show that our industry cares about the environment where we raise pigs. When that message is delivered in person it carries much more weight than any article on the internet.

One of my favorite slides to talk about during my OMS presentations is the versatility of pork. It can be used in almost any style of cuisine. Whether BBQ, Asian, Mexican, or Italian cuisine, pork adds its own unique flavor while not overwhelming the intended flavor of the dish. The nutrition profile adds to this versatility making pork delicious and nutritious! It is wonderful to have a product that has the lowest calorie and fat content of any meat, while still providing high levels of essential vitamins and minerals, along with protein. This nutrition research and information from National Pork Board has made it very easy to confidently proclaim that pork is the best meat.

"Most of the presenters for OMS are pork producers, those of us who are also veterinarians are in a unique position to provide a slightly different perspective."

With OMS as a partner, AASV members can do our part to maintain and improve consumer demand by getting out there and speaking to anyone who will listen about the great attributes of pork. Economists continue to report growing demand as selling more product at a higher price. This domestic demand will keep domestic production sustainable in addition to the good export demand. I think that AASV and OMS can continue to improve demand for pork by speaking to one consumer at a time.

At the end of most of my OMS presentations I usually get a question about what my favorite pork dish is. While not discounting the goodness of bacon, I really like a traditional thick-cut, bone-in pork chop simply grilled to medium (145°F) with SPG (salt, pepper, and garlic)!

Jeff Harker, DVM
AASV President

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[1] Radke, S.L., Olsen, C.W., Ensley, S.M., (2018) Elemental impurities in injectable iron products for swine. *The Journal of Swine Health and Production*, 26(3).

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PHARMACOSMOS

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AASV Annual Meeting update

It is mid-September. The 2021 AASV Annual Meeting, to be held in San Francisco, California, is approximately 6 months away. Currently, San Francisco is prevented from holding large gatherings due to coronavirus disease 2019 (COVID-19) and wildfires are fouling the air to the point that residents are being urged to stay indoors. Our ability to hold a traditional in-person meeting in late February or early March certainly seems in jeopardy.

I have been in negotiations with the San Francisco Marriott Marquis regarding the status of the meeting since late July. To date, I do not have a resolution to those discussions. The Marriott is not yet ready to concede that they will not be able to hold our meeting as contracted. They have indicated that, if we cancel the meeting at this point, AASV would be subject to significant financial penalties as defined by the terms of the contract. It should be noted that there is also a clause in the contract that stipulates that should the hotel not be able to hold the meeting as contracted they would be in violation of the contract and subject to penalties as well. In addition, there is a *force majeure* clause that allows for a no-fault cancellation of the meeting in case certain catastrophic events prevent either party from complying with the terms of the contract. So, as I write this, the format of the meeting (ie, in-person, virtual, or hybrid) is still undecided.

I recently conducted a survey of the membership to gauge your opinion of holding an in-person meeting under the current COVID-19 restrictions and social distancing guidelines. There was a tremendous response to the survey with almost 600 members providing their thoughts. The first thing this tells me is that members value the Annual Meeting enough to take the time to provide us opinions and help us work through our options. Thanks for taking the time to respond.

The results of the survey indicate that 52% of the respondents would not attend an in-person meeting under the current conditions. Of course, that means 48% of the respondents would attend. I was greatly encouraged, however, to see that 80% of the respondents would participate in the Annual Meeting if held virtually. Visit **aasv.org/members/only/2021survey.pdf** to see the complete results of the survey.

Many other groups (eg, the American Veterinary Medical Association, the United States Animal Health Association, the Allen Leman Swine Conference, etc) have decided to transition their meetings to a virtual format. A few, such as the American Association of Bovine Practitioners, are offering a hybrid format with a traditional in-person meeting and livestreaming the sessions for remote participation. The AASV is actively exploring all options. Obviously, however, the need to record and livestream all presentations along with virtual design and access adds additional cost to an already expensive meeting.

While I will continue to work with the hotel, Marriott Global, and our legal advisors, one thing is certain: we will hold the 52nd AASV Annual Meeting. The AASV staff, leadership, and program committee are moving forward with the planning necessary to bring you a great lineup of speakers and topics for the meeting. We are planning to provide remote access to the workshops, scientific sessions, poster sessions, exhibitor booths, and member recognition events that we all look forward to as part of our Annual Meeting. So, now what we need is you.

"The first thing this tells me is that members value the Annual Meeting enough to take the time to provide us opinions and help us work through our options."

I encourage you to register for the meeting and participate in whatever format is offered and with which you are comfortable. The association needs your support. The profit we make from the Annual Meeting is one of three revenue streams supporting the AASV's annual operating expenses. The other two are the annual dues and the revenue generated from selling advertising space in the *Journal of Swine Health and Production* and the AASV e-Letter. The costs for putting on a traditional convention continue to rise. The registration fee you pay along with the generous support of our allied industries through sponsorships and technical table registrations are what pay for the meeting and provide any operating profits going forward. So, I hope that you will continue to find value in the Annual Meeting and register. In addition, please thank our allied industry partners for their continued support and visit their exhibitor offerings to show that their participation is recognized and brings value to the meeting as well. If it were not for their support, we could not put on the quality of the meeting we do without significantly raising registration fees.

Thanks to each of you for your continued support of the association and I look forward to spending some time with you in person or virtually during the 52nd AASV Annual Meeting February 27 – March 2, 2021. Come join us! We will do our best to make it educational, inspirational and, gosh darn it, a little fun.

Harry Snelson, DVM
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It takes a team!

As many of you know, the journal publishes a list of recent reviewers in every November-December issue to recognize and thank them for their contributions to the journal. I went back to re-read my messages from previous November-December issues as it is always good to reflect. I feel that my 2018 and 2019 messages still sum up how I feel about how lucky this journal is to have dedicated reviewers, editorial board members, staff, and authors. The title and content of my message from November-December 2019 "Never too many thank yous!" is still true.[1] Likewise, the title and content of my message for November-December 2018 "Remembering and giving thanks" also still rings true.[2] There is a specific paragraph I would like to highlight from my November-December 2018 message. In the last paragraph I said:

> It seems that the epidemic of "busy schedules" continues to escalate with many of us experiencing increased work demands, and it perhaps seems to be approaching a pandemic phase. I recognize it is often difficult to take on additional work and I hope you can now remember that reviewing a paper thoroughly is a big job requiring the time of many people. ...active recruiting of peer-reviewers remains challenging. Once again, thank you to those who take on extra work during this epidemic of busy schedules.[2]

That almost seemed like dramatic foreshadowing, eh? (eh - a little Canadian colloquialism). Here we are living and experiencing a global pandemic and in 2018 I thought it was cleaver to use the epidemic/pandemic metaphor. But to be serious, I know almost everyone's schedules have changed, and some have changed dramatically as a result of the pandemic. Yet, nearly 100% of our review requests were answered with a yes! So, I feel it is extra prudent for me to thank all the reviewers who have contributed to the journal this year. Thank you.

I ask you to turn to the page of peer reviewers who have volunteered their time and expertise and pause to appreciate their contributions. I also ask you to turn to the inside of the front cover and recognize the editorial board members and staff that make this all happen. And, last but not least, a thank you to the AASV Industry Support Council for their support.

"I ask you to turn to the page of peer reviewers who have volunteered their time and expertise and pause to appreciate their contributions."

Thank you to everyone who has contributed, and continues to contribute, to the success of the journal and for being part of the team!

I hope you enjoy this issue of the journal.

References

1. O'Sullivan, T. Never too many thank yous! [editorial]. *J Swine Health Prod*. 2019;27(6):311.

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Terri O'Sullivan, DVM, PhD
Executive Editor

ORIGINAL RESEARCH PEER REVIEWED

Assessment of nebulization technology for gilt exposure to *Mycoplasma hyopneumoniae* as an acclimation strategy

Sebastián Figueras Gourgues, DVM, PhD; Eduardo Fano, DVM, PhD; Ana Alegre Sabaté, DVM; Elisa López Grasa, DVM; Iván Hernández Caravaca, DVM, PhD; Francisco A. García Vázquez, DVM, PhD; Víctor Rodríguez Vega, DVM; Beatriz Garcia-Morante, DVM, PhD

Summary

Objective: This study assessed the efficacy of nebulization (NEB), also known as fogging, to expose gilts to *Mycoplasma hyopneumoniae* under field conditions as a potential acclimation strategy.

Materials and methods: Phase I consisted of 448 *M hyopneumoniae*-free gilts from four different batches of a gilt development unit (GDU). On study day 0, batches 1 and 2 were exposed to *M hyopneumoniae*-positive lung homogenate via intratracheal (IT) route and were used as reference for batches 3 and 4, which were exposed using a mechanical fogger. Tracheobronchial swabs (TBS) were collected at 2 and 4 weeks post exposure (D14 and D28, respectively) and infection success was assessed by real-time polymerase chain reaction of pooled samples. In phase II, 1160 gilts from the same GDU belonging to three different batches (5 to 7) were exposed to *M hyopneumoniae* via NEB, and TBS were collected at D14.

Results: In phase I, no statistically significant differences were observed between IT and NEB exposure in proportion of positives and mean cycle threshold values of TBS pooled samples at any time point (D14 and D28). In phase II, TBS pooled samples from all batches were positive for *M hyopneumoniae* at D14.

Implications: Nebulization of lung homogenate positive for *M hyopneumoniae* resulted in infection of commercial gilts with this pathogen. Therefore, the use of NEB may be a reliable *M hyopneumoniae* exposure method under field conditions. The information generated in this investigation broadens the understanding of this technology as an acclimation strategy.

Keywords: swine, gilt acclimation, lung homogenate, *Mycoplasma hyopneumoniae*, nebulization

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Resumen - Evaluación de la tecnología de nebulización para la exposición de las primerizas a *Mycoplasma hyopneumoniae* como estrategia de aclimatación

Objetivo: Este estudio evaluó la eficacia de la nebulización (NEB), también conocida como fogueo, para exponer a las primerizas a *Mycoplasma hyopneumoniae* en condiciones de campo como una posible estrategia de aclimatación.

Materiales y métodos: La fase I consistió en 448 primerizas libres de *M hyopneumoniae* de cuatro lotes diferentes de una unidad de desarrollo de primerizas (GDU). El día 0 del estudio, los lotes 1 y 2 se expusieron a un homogeneizado de pulmón positivo a *M hyopneumoniae* por vía intratraqueal (IT) y se utilizaron como referencia para los lotes 3 y 4, que se expusieron utilizando un nebulizador mecánico. Se recogieron hisopos traqueobronquiales (TBS) en las 2 y 4 semanas posteriores a la exposición (D14 y D28, respectivamente) y se evaluó el éxito de la infección mediante la reacción en cadena de la polimerasa en tiempo real de muestras agrupadas. En la fase II, 1160 primerizas de la misma GDU pertenecientes a tres lotes diferentes (5 a 7) se expusieron a *M hyopneumoniae* a través de NEB, y se tomaron TBS en el D14.

Resultados: En la fase I, en ningún momento (D14 y D28) se observaron diferencias estadísticamente significativas entre la exposición IT y NEB en la proporción de positivos y de los valores de umbral de ciclo medio de las muestras agrupadas de TBS. En la fase II, en el D14, las muestras agrupadas de TBS de todos los lotes fueron positivas a *M hyopneumoniae*.

SFG, IHC, FAGV: Department of Physiology, Faculty of Veterinary Science, University of Murcia, Murcia, Spain.

EF: Boehringer Ingelheim Animal Health Inc, Duluth, Georgia.

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AAS, ELG: Piensos Costa, Fraga, Spain.

VRV: Department of Animal Health, Faculty of Veterinary Science, Complutense University of Madrid, Madrid, Spain.

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This article is available online at http://www.aasv.org/shap.html.

This article was derived from Dr Figueras Gourgues' PhD thesis, University of Murcia, Murcia, Spain.

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Implicaciones: La nebulización de homogeneizado de pulmón positivo a *M hyopneumoniae* resultó en la infección de primerizas comerciales con este patógeno. Por lo tanto, el uso de NEB puede ser un método confiable de exposición a *M hyopneumoniae* en condiciones de campo. La información generada en esta investigación amplía la comprensión de esta tecnología como estrategia de aclimatación.

Résumé – Évaluation d'une technologie de nébulisation pour l'exposition de cochettes à *Mycoplasma hyopneumoniae* comme stratégie d'acclimatation

Objectif: Cette étude a évalué l'efficacité de la nébulisation (NEB), également connue sous l'appellation brumisation, pour exposer des cochettes à *Mycoplasma hyopneumoniae* dans des conditions de terrain comme une stratégie potentielle d'acclimatation.

Matériels et méthodes: La phase I consistait en 448 cochettes exemptes de *M hyopneumoniae* provenant de quatre lots différents d'une unité de développement des cochettes (GDU). Au jour 0 de l'étude, les lots 1 et 2 furent exposés à un homogénat de poumon positif pour *M hyopneumoniae* via la voie intratrachéale (IT) et furent utilisés comme référence pour les lots 3 et 4, qui furent exposés à l'aide d'un nébuliseur mécanique. Des écouvillons trachéobronchiques (TBS) furent prélevés à 2 et 4 semaines post-exposition (D14 et D28, respectivement) et le succès de l'infection fut évalué par réaction d'amplification en chaîne par la polymérase en temps réel d'échantillons regroupés. Dans la phase II, 1160 cochettes provenant de la même GDU et appartenant à trois lots différents (5 à 7) furent exposées à *M hyopneumoniae* via NEB, et des TBS prélevés à D14.

Résultats: Dans la phase I, aucune différence statistiquement significative ne fut observée entre l'exposition IT et NEB en proportion de positifs et des valeurs moyennes de seuil de cycles des échantillons de TBS regroupés à n'importe quel point d'échantillonnage (D14 et D28). Dans la phase II les échantillons groupés de tous les lots étaient positifs pour *M hyopneumoniae* à D14.

Implications: La nébulisation d'un homogénat de poumon positif pour *M hyopneumoniae* a résulté en une infection de cochettes commerciales avec cet agent pathogène. Ainsi, l'utilisation de NEB pourrait être une méthode fiable d'exposition à *M hyopneumoniae* dans des conditions de terrain. L'information générée dans cette étude élargie la compréhension de cette technologie dans une stratégie d'acclimatation.

Mycoplasma hyopneumoniae is the etiologic agent of mycoplasmal pneumonia, a chronic bronchopneumonia which impacts swine health worldwide.[1] Infection with *M hyopneumoniae* predisposes pigs to infections with other respiratory bacteria and viruses, playing an important role in more clinically and economically relevant diseases known as enzootic pneumonia (EP) and the porcine respiratory disease complex (PRDC).[1] Despite all efforts implemented to reduce the economic impact attributed to *M hyopneumoniae*, EP and the PRDC are still associated with important economic losses to the swine industry.

Although indirect contact has importance in the infection dynamics of *M hyopneumoniae*, direct nose-to-nose contact between infected and susceptible pigs is considered the main route of transmission.[2] First exposure to *M hyopneumoniae* occurs during lactation when piglets may become infected in the farrowing unit through shedding sows.[3-5] Several studies have demonstrated that piglets may be colonized during the lactation period and are then positive with this bacterium when weaned.[6-9] Moreover, it has been shown that disease severity in growing pigs could be correlated with *M hyopneumoniae* piglet prevalence at weaning.[9,10]

Circulation of *M hyopneumoniae* is thought to occur among existing sows and be transmitted to incoming gilts.[3] An inverse relationship between parity number and *M hyopneumoniae* shedding has been described, thus, gilts and low parity sows infected for the first time are considered the main source of the bacteria to suckling piglets.[2,11,12] In addition, the existence of negative subpopulations that can reach 20% of the gilt population have been described in positive herds.[13] This, together with *M hyopneumoniae* shedding that can persist up to 214 days post infection,[14] make the implementation of an early and proper gilt acclimation process against *M hyopneumoniae* of paramount importance. Therefore, an adequate gilt acclimation pursues the elimination of bacterial shedding at first farrowing to minimize piglet colonization and later problems in the growing phase.[15,16]

Vaccination is the main strategy used for replacement gilt acclimation procedures against *M hyopneumoniae* in both Europe and North America.[16] Vaccination protects the gilts although it does not stop them from being infected and shedding the organism.[17,18] Another frequently used acclimation strategy is direct contact with pigs that are suspected to be infected.[19-21] In this strategy, a uniform infection with *M hyopneumoniae* is difficult to achieve as transmission is known to be very slow.[22,23] To increase the success of infection, the use of lung tissue homogenate containing *M hyopneumoniae* to deliberately infect replacement gilts has been recently reported in the United States and Mexico.[20,21,24,25]

Controlled exposure of naïve gilts to *M hyopneumoniae* infective material might be a complementary method for gilt acclimation that deserves further investigation. The intratracheal (IT) method is the most widely used in *M hyopneumoniae* experimental inoculation procedures.[26] However, due to the difficulty that this method represents at a large scale in the swine industry, this study assessed the efficacy of *M hyopneumoniae* exposure using nebulization (NEB), also referred to as fogging, under field conditions. Efficacy of exposure was determined by real-time polymerase chain reaction (qPCR) testing of pooled tracheobronchial swabs (TBS) collected at 2 and 4 weeks post exposure to confirm *M hyopneumoniae* infection.

Materials and methods

Animals and housing

The study was conducted from July 2017 to June 2018 in a 2200-head gilt development unit (GDU) located in Aragón, Spain. This farm consists of two barns, each 854 m^2; each barn had two 420 m^2 units. The gilts (Landrace × Large White crossbred) in the study were housed in 9 m^2 pens in groups of 10 within the same unit. The GDU worked in batches depending on sow farm demand and used an all-in/all-out management system. Feed and water were available *ad libitum* in stainless steel feeders and through water nipples, respectively. Gilts were raised in facilities with fully slatted floors and fed

a diet to meet or exceed their nutritional needs. All animals were under veterinary oversight and care with a veterinarian-client-patient relationship and a Welfare Quality based certification in place (animal welfare certification by Asociación Española de Normalización y Certificación). Gilts weighed approximately 20 kg upon entry to the GDU (approximately 7 weeks of age) and approximately 100 kg upon departure from the GDU (approximately 28 weeks of age). All gilts were obtained from a unique nucleus and multiplier pig farm known to be negative for *M hyopneumoniae*, wild type porcine reproductive and respiratory syndrome virus (PRRSV), and influenza A virus. The routine vaccination program included immunization against PRRSV, Aujeszky's disease virus, influenza A virus, porcine parvovirus, *Erysipelothrix rhusiopathiae*, *Actinobacillus pleuropneumoniae*, porcine circovirus type 2, and *M hyopneumoniae* as a growing pig (starting at 10-12 weeks of age) followed by a booster immunization 3 to 4 weeks apart. Prior to study initiation, no signs of any major pig diseases were observed. No antimicrobials were administrated to gilts under study.

Experimental design and sample collection

This research consisted of two phases: phase I had a total of 448 gilts from 4 batches (1-4) and phase II had 1160 gilts from 3 batches (5-7). The experimental design is presented in Table 1. In all cases, batches were formed with a varying number of gilts and exposure to *M hyopneumoniae* occurred at 10 to 13 weeks of age (study day 0). In phase I, batches 1 and 2 were used as positive controls and were inoculated via IT, while batches 3 and 4 were exposed to the pathogen by NEB. In phase II, all batches (5-7) were exposed to *M hyopneumoniae* via NEB at 10 to 13 weeks of age. In each batch, a subgroup of 30 gilts was randomly selected and monitored for infection confirmation during the acute phase of infection. For this purpose, TBS were collected at 2 and 4 weeks post exposure (D14 and D28, respectively) in phase I, and at D14 in phase II.

M hyopneumoniae infectious material

The infectious material for batches 1 and 2 was obtained from a commercial farrow-to-wean herd with EP problems in replacement gilts at entry and in offspring at finishing stages. The herd received gilts from the GDU used in this study. Ten, clinically affected, 24-week old gilts were selected and subjected to TBS sampling. The seed material donor was identified based on the minimum presence of other swine respiratory pathogens and the lowest cycle threshold (Ct) to *M hyopneumoniae* as determined by qPCR and described by Robbins et al.[27] Subsequently, the selected donor was euthanized, necropsied, and the lung tissue was used to prepare the seed tissue homogenate. For batches 3 and 4, seven gilts from the GDU were artificially inoculated with *M hyopneumoniae* (batch 1), euthanized, and necropsied. Seed material donors were selected by testing lung homogenate and using qPCR and the same criteria previously mentioned. In this case, lungs from 3 gilts were selected to proceed with the seed tissue homogenate preparation. Lastly, lungs from 10 gilts belonging to previous GDU batches exposed to *M hyopneumoniae* were used for the seed lung homogenate preparation for batches 5, 6, and 7. In all cases, seed tissue homogenates were prepared roughly as a ratio of 6 g of lung tissue for every 4 mL of homemade Friis medium. Thereafter, the homogenates were confirmed to be positive for *M hyopneumoniae* and stored in 30 mL aliquots at -80°C until used. Presence of *M hyopneumoniae* and other pathogens in the three seed lung homogenates are shown in Table 2.

M hyopneumoniae inoculation

Gilts from batches 1 and 2 (phase I) were inoculated once via IT with 10 mL of inoculum. The inoculum was prepared with the seed lung homogenate at a dilution of 1:50 in Friis medium and at a final concentration of 4.6×10^6 genome copies/mL, as determined by qPCR. The inoculation technique was performed as previously described by Pieters et al,[14] but without the use of anesthesia. Briefly, a post cervical insemination catheter (Magaplus; Magapor) was used for lung homogenate delivery into the trachea, and a laryngoscope and a mouth gag used for visualization. An electric portable aerosol applicator (Hurricane Ultra; Curtis Dyna-Fog Ltd) was used to expose gilts in batches 3 to 7 (phase I and II) to *M hyopneumoniae* via NEB. In this case, inoculum was prepared with the seed lung homogenate at a dilution of 1:50 in Friis medium and grossly filtered to discard tissue debris to avoid equipment malfunction. In phase I, inocula final concentrations of *M hyopneumoniae* were 6.6×10^6 and 8.9×10^6 genome copies/mL in batch 3 and 4, respectively. In phase II, inocula final concentrations were 1.1×10^4, 2.1×10^5, and 1.6×10^7 genome copies/mL in batch 5, 6, and 7, respectively. Infectious material was administered with a total output rate of approximately 236 mL/min at 220 volts over 2 minutes in each pen housing 10 gilts. The fogger was manually focused toward the gilts' snouts and a left-right movement made to ensure that all animals inhaled the aerosol. The particle sizes generated ranged from 7 to 30 μm of volume mean diameter depending on the flow rate and viscosity of the inoculum. During the NEB procedure, all barn windows were closed to avoid air flows that could interfere with the exposure of the gilts to the infectious material. Additionally, all personnel that

Table 1: Experimental design for gilts artificially exposed to *M hyopneumoniae* using two inoculation techniques

Study phase	Batch No.	No. of gilts	D0 Inoculation method	TBS*	
				D14	D28
I	1	88	IT	yes	yes
	2	120	IT	yes	yes
	3	120	NEB	yes	yes
	4	120	NEB	yes	yes
II	5	370	NEB	yes	no
	6	386	NEB	yes	no
	7	404	NEB	yes	no

* Thirty gilts within each batch were randomly selected for TBS sampling for *M hyopneumoniae* detection by qPCR.

TBS = tracheobronchial swabs; IT = intratracheal; NEB = nebulization; qPCR = real-time polymerase chain reaction.

Table 2: Presence of *M hyopneumoniae* and other pathogens in seed lung homogenates for gilt exposure

	Ct values		
Pathogen tested	**Batches 1 and 2**	**Batches 3 and 4**	**Batches 5, 6, and 7**
PRRSV-1*	Neg	32.89	Neg
PRRSV-2	Neg	Neg	Neg
Influenza A virus	Neg	Neg	Neg
Porcine circovirus type 2	Neg	Neg	Neg
***M hyopneumoniae*†**	**23.82**	**23.90**	**20.99**
Mycoplasma hyorhinis	Neg	25.98	Neg
Actinobacillus pleuropneumoniae	Neg	Neg	33.46
Streptococcus suis	Neg	Neg	Neg
Pasteurella multocida	26.36	Neg	33.24
Haemophilus parasuis	Neg	Neg	Neg
Bordetella bronchiseptica	Neg	Neg	Neg

* Pathogen detected had > 98% homology with the vaccine PRRSV strain by comparing open reading frame 5 sequences.
† A sample was considered positive for *M hyopneumoniae* when the Ct value was ≤ 38.
Ct = cycle threshold; PRRSV = porcine reproductive and respiratory syndrome virus; Neg = negative.

could be putatively exposed to the aerosol used personal protection equipment including a respirator (3M 4279 Reusable Half Face Masks; 3M) and goggles (3M GoggleGear 500 Series GG501SGAF; 3M).

Sample collection, processing, and testing

Thirty gilts within each exposed batch were randomly selected for TBS sampling at D14 and D28, which were obtained as previously described by Fablet et al.[28] A gilt was restrained with a nose snare and a mouth gag and laryngoscope were used for visualization. A post cervical insemination catheter was used to reach the trachea-bronchial bifurcation where mucus was collected through gentle catheter movement. The tip of the catheter (2-cm diameter) was placed in a 5 mL BD Serum Vacutainer tube (Becton Dickinson and Company), mixed with 2 mL sterile saline, and refrigerated until testing. Individual TBS were tested in pools of 5. Each sample or sample pool was sent to EXOPOL S.L.U. (Zaragoza, Spain) and analyzed using an *M hyopneumoniae* specific qPCR (EXOone *M hyopneumoniae* one-MIX qPCR; EXOPOL S.L.U.), which has been validated using a DNA purification kit (UltraClean Tissue & Cells DNA Isolation Kit; MOBIO Lab, Inc) for DNA extraction. The qPCR kit contains an endogenous control to avoid false negative results and ensure that the entire process has been correctly performed. A sample was considered positive for *M hyopneumoniae* when the Ct value was ≤ 38.

Data analysis

Statistical analyses and data summaries were performed using Graph Pad Prism 8 software. All data were summarized descriptively based on the type of variable and analyzed assuming a completely random design structure. An analysis of variance through the ordinary one-way ANOVA was applied for mean comparison of qPCR Ct values among gilt batches at D14 and D28. The Chi square test was used to evaluate the proportion of positive qPCR samples between groups at different sampling points. Tests on differences were designed as 2-sided tests at $\alpha = .05$, with differences considered significant if $P \leq .05$.

Results

Phase I: Batches exposed via IT vs NEB

The Ct values of the positive TBS pooled samples in the acute phase of infection (D14 and D28) from batches 1 to 4 are shown in Figure 1. Overall, no statistically significant differences were observed in proportion of positive TBS pooled samples or in potential bacterial load (mean Ct value) between batches at any time point. At D14, all samples were positive for *M hyopneumoniae* in all batches, regardless of the exposure method (ie, IT or NEB). At D28, 4 of 6 (66.7%) TBS pooled samples were positive for *M hyopneumoniae* in batch 1, 5 of 6 (83.3%) samples were positive in batches 2 and 3, and 6 of 6 (100%) samples were positive in batch 4.

Phase II: Batches exposed via NEB

The Ct values of the positive TBS pools in the acute phase of infection (D14) from batches 5 to 7 are shown in Figure 2. No statistically significant differences were observed in proportion of positive TBS pools or in indicative bacterial load (mean Ct value) between batches at D14. In parallel to phase I, all pooled samples were positive for *M hyopneumoniae* in all batches at D14.

Discussion

Because gilts might be the major source of *M hyopneumoniae* to newborn pigs,[2,3] a suitable gilt acclimation focused on reducing the bacterial shedding at first farrowing has been suggested.[15] Information on gilt acclimation strategies for *M hyopneumoniae* is limited; a recent review has pointed out that vaccination is the main strategy used in Europe, Mexico, and the United States.[16] Vaccination of gilts for *M hyopneumoniae* at acclimation may be effective to decrease shedding and infectious pressure,[29] however, studies under experimental[18] and field conditions[7,30] showed that vaccination did not prevent infection and transmission of

Figure 1: Tracheobronchial swab (TBS) sampling two (D14) and four (D28) weeks post exposure to *M hyopneumoniae* using two inoculation methods. Individual and mean (SD) Ct values of positive TBS pooled samples using a qPCR test for *M hyopneumoniae*. Ct = cycle threshold; qPCR = real-time polymerase chain reaction; IT = intratracheal; NEB = nebulization.

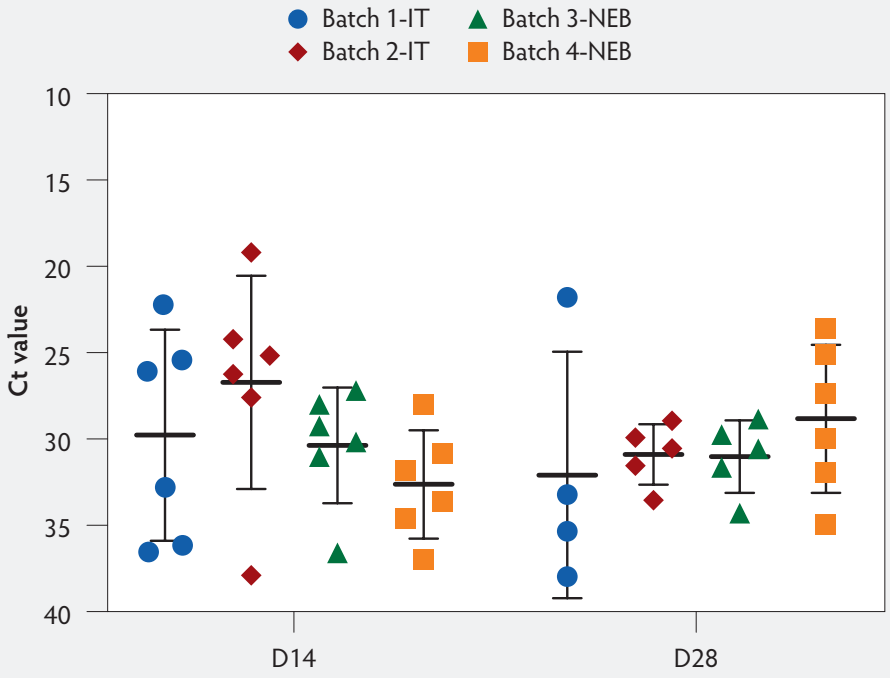
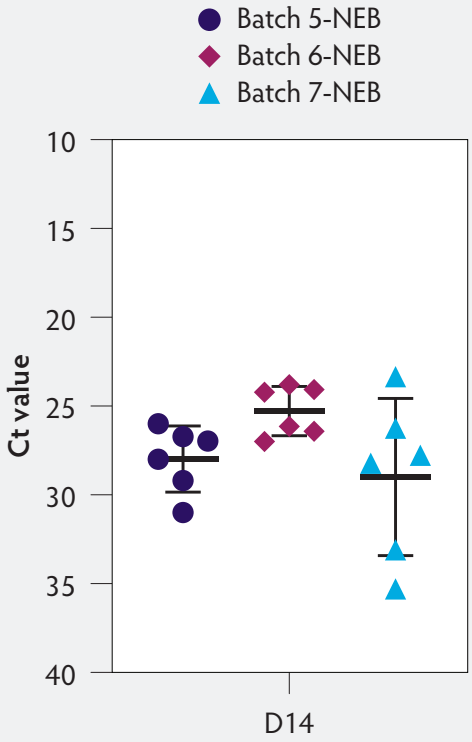


Figure 2: Tracheobronchial swab (TBS) sampling two weeks (D14) post exposure to *M hyopneumoniae* using nebulization inoculation. Individual and mean (SD) Ct values of positive TBS pooled samples using a qPCR test for *M hyopneumoniae*. Ct = cycle threshold; qPCR = real-time polymerase chain reaction; NEB = nebulization.



the pathogen. To control the time of infection with *M hyopneumoniae* and minimize the likelihood of bacterial shedding at the first farrowing, early controlled exposure has been attempted by administering lung tissue homogenate containing *M hyopneumoniae* to replacement gilts.[20,21,24,27] Inoculation with lung homogenate prepared from infected pigs might have the potential to introduce adventitious agents and aggravate the inflammatory response due to the administration of foreign antigens.[31] While the use of *M hyopneumoniae* pure culture would avoid these concerns, this bacterium is notoriously fastidious, and bacterial culture remains challenging and time consuming.[32] Moreover, potential legal aspects could arise from the use of bacterial isolates at farm level.

To intentionally infect pigs with *M hyopneumoniae*, the IT inoculation route has been extensively used under experimental settings.[26] The IT route is expected to apply a greater inoculum volume to the pig's lower respiratory tract, achieving greater infectious doses in shorter times and promoting an earlier *M hyopneumoniae* colonization.[33] Nevertheless, IT application is labor intensive, time consuming, and invasive. Practically, these factors present a great challenge to implementation of this method on a large scale in the swine industry. Another option would be the controlled exposure of naïve gilts to knowingly shedding animals (seeders). Roos et al[23] concluded that 6 seeders infected via IT were required in a group of 10 gilts for successful exposure to *M hyopneumoniae* in a 4-week exposure period. Due to the high ratio of infected animals needed and the unfeasibility of the IT methodology under field conditions, practical alternatives to ensure infection with *M hyopneumoniae* are needed. While NEB is supposed to closely mimic the natural conditions of *M hyopneumoniae* infection, it may also pose some constraints such as biosecurity and biocontainment issues, or lower dosage accuracy. In earlier work, pigs inoculated via IT displayed a significantly earlier upper respiratory tract colonization of *M hyopneumoniae* compared to those inoculated through NEB using individual exposure via an inhalation mask.[33] This finding could suggest a certain time lag in *M hyopneumoniae* infection dynamics partly due to the method of pathogen exposure. The present study assessed the validity of NEB to purposely expose naïve gilts to *M hyopneumoniae* in a field context.

In this framework, efficacy of NEB to infect gilts was evaluated by collecting TBS after exposure (D14 and D28) and testing pooled TBS by qPCR.

Tracheobronchial swab sampling in combination with qPCR testing for *M hyopneumoniae* has been introduced as an innovative technique to consistently detect the pathogen in different contexts.[28,34-38] It has been suggested that TBS is the most sensitive antemortem sample available to assess *M hyopneumoniae* prevalence in a pig population.[35,38] In our study, 30 TBS were collected per batch and time point. This sample size is widely used in the field to detect at least 1 positive from a population of 1000 pigs, assuming a 10% prevalence and 95% CI.[39] Applying this to the present research, at least one negative exposed pig per batch would have been detected by using this sample size. However, to significantly reduce the number of tests and associated costs, samples were submitted for testing in pools of 5. While this dilution step has been proposed as the preferential approach for field studies collecting TBS,[24,35,40] pooling more than one animal for each sample minimizes the effects of biological variation between individuals. In this context where high prevalence and low Ct values are expected, there is a risk of not detecting negative animals in a pool. This can certainly be understood as a limitation of the study as it can give false confidence about the data significance. Nevertheless, there is evidence in the literature that prove it unlikely that the pooled positive samples from this study were mainly composed of negative individual TBS. According to Sponheim et al,[38] the cumulative incidence of *M hyopneumoniae* infection, as detected by individual TBS, was 100% at about 14 weeks post infection in pigs inoculated via IT. A previous work using a mechanical fogger to expose gilts to *M hyopneumoniae* reported 100% positive individual TBS between 8 and 11weeks post fogging.[25] More recently, 100% of pooled TBS were PCR positive to *M hyopneumoniae* at 14 days post infection in pigs also exposed by NEB.[24] In this latter case, all samples were tested individually and every sample was confirmed PCR positive.

Overall, data obtained in the present study support the idea that NEB may be a convenient and effective methodology to infect gilts with *M hyopneumoniae* for acclimation purposes. Tracheobronchial swab pooled samples revealed no statistically significant differences in proportion of positives or in mean bacterial loads between batches early after exposure via IT and NEB. Although real prevalence of negative animals to *M hyopneumoniae* after exposure could not be addressed, the only pooled TBS samples that tested negative were collected on D28 from gilts exposed by both the IT and NEB routes. Due to the high analytical sensitivity yield by qPCR, all individuals within the negative pools are generally considered negative. However, and using PRRSV as an example, about 6% of the samples that would be detected by reverse-transcriptase PCR on individual serum would be missed if they were run in pools of 5.[41] In processing fluids, samples with initial Ct values of 35 would fall above the suspect threshold if further diluted.[42] However, pools that test positive indicate that at least one individual within each pool is positive, and individual retesting of each specimen is needed to discern between positives and negatives. Unfortunately, retesting of individual TBS samples could not be performed in this study as prepooled samples were not available. Moreover, to the knowledge of the authors, there is no literature assessing the changes in Ct values of *M hyopneumoniae* positive TBS pools due to the presence of negative samples. In consequence, the existence of negative subpopulations after exposure to *M hyopneumoniae* by the NEB technology cannot be discarded. Whether such negative subpopulations shortly after exposure influence the efficacy of acclimation strategies in reducing *M hyopneumoniae* shedding and prevalence of disease in downstream flow is unexplored and needs to be addressed in future work. Another scenario would be a herd undergoing an *M hyopneumoniae* elimination protocol. In this case, the presence of susceptible subpopulations represents a major risk for program failure,[43] which emphasizes the need to develop accurate diagnostic protocols to determine the success of *M hyopneumoniae* exposure. In summary, tailored diagnostic protocols are needed to reach the objective pursued with each acclimation strategy, which can be either control (low prevalence) or eradication of the infection.

Besides the inoculation methodology, successful exposure to *M hyopneumoniae* was also observed irrespective of the inoculum bacterial concentration. Thus, different titrations (expressed as genome copies per mL) of the final lung tissue homogenates were obtained, but no significant differences in proportion of positivity or in bacterial loads from TBS pooled samples were detected between any of the batches. While many other factors are probably involved, qPCR is not indicative of the bacterium viability in the inoculum as DNA fragments have been reported to be present in culture for long periods even when *M hyopneumoniae* cells are no longer viable.[44]

Mycoplasma hyopneumoniae-infected pigs via IT can potentially excrete the bacterium for up to 214 days following initial infection,[14] though the duration of shedding could vary in naturally infected gilts under field conditions.[29] In the present study, no excretion data was obtained late post exposure. This information for NEB also is lacking in the literature, thus, whether the excretion pattern is different in pigs exposed to *M hyopneumoniae* by NEB remains unknown and should be the subject of further investigation. The age of exposure has major importance when the goal is to obtain nonshedding gilts by the time of first farrow. Gilts from the present study entered and left the GDU at approximately 7 and 28 weeks of age, respectively, and the age at first mating was about 35 weeks. Considering a shedding duration of 214 days (approximately 31 weeks) and that the acclimation process started around 10 to 13 weeks of age, the protocol used in this study would likely have ensured the elimination of *M hyopneumoniae* shedding at first farrowing, as suggested by Pieters and Fano.[15] Regrettably, *M hyopneumoniae* status of gilts at first farrowing was not checked, therefore, it remains unknown whether this acclimation protocol was effective in reducing bacterial shedding at that critical time. Also, there are numerous factors that could impact the duration of *M hyopneumoniae* shedding, for instance, the immunological status of the infected animals. The gilts enrolled in this study were vaccinated against *M hyopneumoniae* before their entrance to the GDU. In naturally infected gilts under field conditions, a lower duration of *M hyopneumoniae* shedding has been suggested in vaccinated gilts when compared to their nonvaccinated counterparts.[29] The latter, however, should be corroborated in experimentally inoculated animals where the exact time of exposure to *M hyopneumoniae* is known. Still, protocols including exposure of vaccinated gilts could be advantageous for reducing acclimation timings.

Implications

- Gilt acclimation to *M hyopneumoniae* is key for sustainable EP and PRDC control.
- Controlled exposure to *M hyopneumoniae* may be a complementary acclimation method.
- Nebulization could be used consistently to expose gilts to *M hyopneumoniae*.

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Conflict of interest

None reported.

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Conversion tables

Weights and measures conversions

Common (US)	Metric	To convert	Multiply by
1 oz	28.35 g	oz to g	28.4
1 lb (16 oz)	453.59 g	lb to kg	0.45
2.2 lb	1 kg	kg to lb	2.2
1 in	2.54 cm	in to cm	2.54
0.39 in	1 cm	cm to in	0.39
1 ft (12 in)	0.31 m	ft to m	0.3
3.28 ft	1 m	m to ft	3.28
1 mi	1.6 km	mi to km	1.6
0.62 mi	1 km	km to mi	0.62
1 in^2	6.45 cm^2	in^2 to cm^2	6.45
0.16 in^2	1 cm^2	cm^2 to in^2	0.16
1 ft^2	0.09 m^2	ft^2 to m^2	0.09
10.76 ft^2	1 m^2	m^2 to ft^2	10.8
1 ft^3	0.03 m^3	ft^3 to m^3	0.03
35.3 ft^3	1 m^3	m^3 to ft^3	35
1 gal (128 fl oz)	3.8 L	gal to L	3.8
0.264 gal	1 L	L to gal	0.26
1 qt (32 fl oz)	946.36 mL	qt to L	0.95
33.815 fl oz	1 L	L to qt	1.1

Temperature equivalents (approx)

°F	°C
32	0
50	10
60	15.5
61	16
65	18.3
70	21.1
75	23.8
80	26.6
82	28
85	29.4
90	32.2
102	38.8
103	39.4
104	40.0
105	40.5
106	41.1
212	100

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

Conversion chart, kg to lb (approx)

Pig size	Lb	Kg
Birth	3.3-4.4	1.5-2.0
Weaning	7.7	3.5
	11	5
	22	10
Nursery	33	15
	44	20
	55	25
	66	30
Grower	99	45
	110	50
	132	60
Finisher	198	90
	220	100
	231	105
	242	110
	253	115
Sow	300	135
	661	300
Boar	794	360
	800	363

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

Case Study

Peer reviewed

Clinical hyperestrogenism associated with unintentional phytoestrogenic soybean intake

Josh Timmer, BVSc; Damian Holden, DVM; Peter C. Scott, BVSc, PhD; Steven McOrist, BVSc, PhD

Summary

This case study characterizes breeding performance related to unintentional dietary intake of phytoestrogenic compounds. Breeder farms A (affected) and B (unaffected) were under single management and supplied by two unconnected feed mills. Breeding parameters were recorded over 2 years and feed analyzed for mycotoxins and isoflavonoids. Farm B had consistently better breeding performance. Clinical signs of hyperestrogenism (vulval tumefaction, mammary gland dysfunction, and delayed estrus) were evident in 5% to 10% of breeding females on farm A. Mycotoxin concentrations were negligible, but phytoestrogenic isoflavonoid concentrations associated with one source of soybean meal were above 55,000 µg/kg on farm A.

Key words: swine, fertility, phytoestrogens, hyperestrogenism, soybean meal

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Resumen - Hiperestrogenismo clínico asociado con la ingesta no intencional de soya fitoestrogénica

Este estudio de caso caracteriza el desempeño reproductivo relacionado con la ingesta dietética no intencional de compuestos fitoestrogénicos. Las granjas reproductoras A (afectada) y B (no afectada) estaban bajo una misma administración y eran abastecidas por dos fábricas de alimento no relacionadas. Los parámetros de reproducción se registraron durante 2 años y el alimento se analizó en busca de micotoxinas e isoflavonoides. La granja B tuvo un rendimiento reproductivo consistentemente mejor. Los signos clínicos de hiperestrogenismo (tumefacción vulvar, disfunción de la glándula mamaria y estro retardado) fueron evidentes en el 5% al 10% de las hembras reproductoras en la granja A. Las concentraciones de micotoxinas fueron insignificantes, pero las concentraciones de isoflavonoides fitoestrogénicos asociados con una fuente de harina de soya fueron superiores a 55,000 µg/kg en la granja A.

Résumé - Hyperœstrogénisme clinique associé avec l'ingestion non-intentionnelle de soja phyto-œstrogénique

La présente étude de cas caractérise les performances de reproduction reliées à l'ingestion non-intentionnelle de composés phyto-œstrogéniques alimentaires. Les fermes de reproduction A (affectées) et B (non-affectées) étaient sous un même système de gestion et étaient fournies en aliment par deux meuneries non-associées. Les paramètres de reproduction furent enregistrés sur plus de 2 ans et la moulée analysée pour les mycotoxines et les isoflavonoïdes. La ferme B présentait constamment de meilleures performances de reproduction. Des signes cliniques d'hyperœstrogénisme (tuméfaction vulvaire, dysfonctionnement de la glande mammaire et œstrus retardé) étaient évidents chez 5% à 10% des femelles reproductrices sur la ferme A. Les concentrations de mycotoxines étaient négligeables, mais les concentrations d'isoflavonoïdes phytoœstrogéniques associées avec une source de soja étaient supérieures à 55,000 µg/kg sur la ferme A.

Several naturally occurring exogenous compounds can occupy and stimulate estrogen receptors located in reproductive and other organs, thereby mimicking the action of endogenous estrogen. Pigs have two main estrogen receptors (ERα and ERβ), both are considered highly susceptible to exogenous mimics. Clinical outbreaks of hyperestrogenism due to oral intake of the heat-stable zearalenone mycotoxin derived from *Fusarium* contamination of cereals, particularly corn, are well documented in pigs and other mammals.[1,2]

The occurrence of hyperestrogenism due to oral intake of estrogenic isoflavonoids, such as genistein, daidzin, and daidzein is also well documented in rodents.[3,4] but less so in pigs. Isoflavonoids particularly occur as phytoestrogenic components of soybean cultivars (*Glycine max*), and are much more abundant in its growing leaves and roots.[5] Clinical outbreaks of hyperestrogenism have occurred in rodents unintentionally fed commercial diets containing soybean ingredient material with high levels of isoflavonoids.[4] Analysis of these suspect diets indicated that clinical signs could occur with dietary levels of isoflavones in the order of 1000 to 24,000 µg/kg of feed.[4] Dietary intake of soybean phytoestrogens has also been implicated in a range of human reproductive organ effects, such as infertility due to disruption of estrus and increased breast tissue density.[6] Previous studies in pigs have been largely limited to *in vitro* and intentional challenge exposure studies.[7,8] Testing of pig feed components for phytoestrogens has been minimal due to the limited availability and expensive nature of the high-performance liquid chromatography (HPLC) analysis required.

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Timmer J, Holden D, Scott PC, McOrist S. Clinical hyperestrogenism associated with unintentional phytoestrogenic soybean intake. *J Swine Health Prod.* 2020;28(6):302-309.

In this case study, we describe the clinical hyperestrogenic signs associated with the dietary intake of phytoestrogen isoflavonoids in 2 breeding herds.

Case description

Case farms and breeding herds

Breeding farms A and B under a single management group were located in the subtropical dry climate zone of mid Queensland, Australia. The breeding herd genetics for both farms were of a single source of synthetic Large White-Landrace crossbred pigs, with semen for artificial insemination supplied from a commercial boar stud. No new genetics were introduced to the farms between 2017 and 2019. Over this time, farms A and B had a mean population of 3550 and 1050 breeding age females, respectively, with weaned pigs taken to separate nursery and grower facilities. Female grower pigs were selected for re-entry to both breeding herds at 22 weeks of age based on leg conformation, teat conformation, and vulva characteristics. Gilt preparation consisted of physical boar exposure after 24 weeks of age. Gilts entered the estrus detection and mating program at 27 weeks of age, with the first mating upon second estrus at 30 to 36 weeks of age. Both breeding herds had been free of clinical signs or other evidence associated with parvovirus, classical swine fever virus, porcine reproductive and respiratory syndrome virus, and pathogenic porcine circovirus as monitored by ongoing necropsy, specific serology, and immunohistochemistry studies for 10 years preceding and throughout the case study period (2017-2019).

Monitoring of breeding pig performance

Breeding procedures on both farms were under the same management, and of industry standard to the same audited operating procedures. Staff retraining to all breeding procedures occurred under veterinary supervision 4 times each year. Breeding females were monitored for estrus by reaction to boar and back pressure test. Mating procedures consisted of artificial insemination with physical presence of a boar and placement of a back-brace boar simulator device. Insemination on both farms consisted of two 80 mL doses (24 hours apart) of Large White or Landrace semen from the same group of nucleus herd boars. Pregnancy confirmation was conducted via ultrasound device at 28 and 56 days post mating. After farrowing, weaning occurred 22 to 28 days later. Two days after weaning, physical boar exposure was provided to sows until estrus and mating. A weaning-to-service interval of 7 days or less was considered normal. After 7 days, any unmated sows were placed into a separate "stales" pen, and further physical boar exposure provided.

Calculations were conducted weekly (June 2017 to June 2019) to determine incidence of estrus, conception and pregnancy rates (positive pregnancy at 28 and 56 days post mating, respectively), farrowing rates, wean-to-service intervals, litters produced per mated female per year, nonproductive days (breeding female days without pregnancy or lactation), number of piglets born alive, and piglets weaned per sow per year. Any clinical signs in the breeding pigs and offspring were recorded.

Diets and laboratory analyses

Farms A and B were each supplied separately by two unconnected feed mills (A1 and B1, 200 km apart), which both formulated pig stage-specific compound feeds. Each formulated diet consisted of proportionate wheat-barley-sorghum cereals with soybean or canola protein sources and other standard feed additives. Pigs were fed via dedicated silos, in-line augers, and pen hoppers. Any in-feed antibiotic medications were supplied by veterinary prescription and included in diets destined solely for the target group of pigs. Commercial mycotoxin adsorptive products (clay-silicate) were added to every diet at the dosages recommended by the manufacturers.

On two occasions in 2018 (February and May), 9 scoops of feed were taken from various pen hoppers and then homogenized for analysis, and this occurred on each farm. Analysis of these compound feeds was performed for known isoflavonoids by standard HPLC analysis coupled with mass spectrometry (MS).[9] In brief, 5 g of each feed sample was extracted by acetonitrile/water/acetic acid for 90 minutes, diluted, then screened and quantified in selected reaction monitoring mode within the HPLC/MS (Agilent biosystems, IFA-Tulln, University of Natural Resources and Life Sciences, Vienna, Austria). Two transitions leading to 4 identification points were established for each analyte, with calibrations performed via serial dilutions of a multi-analyte stock solution.

For mycotoxin testing, the feeds were also sampled in the same manner every 2 months (n = 10). Analysis of these compound feeds was performed for 23 known mycotoxins by a commercial liquid-liquid analysis coupled with mass spectrometry (Spectrum 380; Biomin).

Case investigations

Pregnant breeding pigs were fed a stage-specific diet for gestation (dry sow diet) then switched to a lactation diet starting at 10 days prior to farrowing, then reverting to the dry sow diet after the next estrus and remating. At farm A only, an additional diet (also from the feed mill A1) was provided for the females during the weaning-to-service period. Formulations for these diets varied slightly over the 2 years depending on ingredient availability. Feed mills A1 and B1 respectively formulated 500 and 100 metric tons of pig feed weekly, and therefore formulated 11 and 8 diets, respectively, over the study period. The median and range of ingredients used in these diet formulations are listed in Table 1. The cereal, oil, and additive diet components were generally similar, however, soybean meal and mill run (feed mill remainder) content of lactation and wean-to-service diets were consistently higher in farm A diets, whereas canola meal and chickpeas were used more in farm B diets (Table 1). Dietary ingredients for feed mills A1 and B1 were supplied from different local and global sources. The soybean meal used in feed mill A1 was supplied by a major global feed company and sourced via container from Argentina. The imported soybean meal had been emptied and held in a single bulk silo at a port distribution center. This bulk silo supplied soybean meal to feed mill A1 every 2 weeks.

For farms A and B, conception rates were 96.4% and 98.6%, pregnancy rates were 95.0% and 98.4%, and farrowing rates were 86.6% and 91.5%, respectively (Figure 1). The litters farrowed per mated female per year were 2.32 and 2.43 and pigs weaned per sow per year were 23.7 and 24.7 on farms A and B, respectively (Figure 2). The wean-to-service interval was 6.8 and 6.4 days and nonproductive days were 40.8 and 30.4 on farms A and B, respectively (Figure 3). The number of piglets born alive per litter (11.7 and 11.6) and the number of piglets weaned per litter (10.2 and 10.1) were similar in farms A and B. We therefore noted a consistently better breeding performance in pigs on farm B (considered unaffected).

Clinical signs were only evident in 5% to 10% of breeding females on farm A during the approximate 120 farrowing events per

Table 1: Median (range) of ingredient inclusion in pig diets for 2 sow farms

Diet ingredient, kg/metric ton*	Feed mill A1†			Feed mill B1†	
	Gestation	Lactation‡	Wean-to-Service	Gestation	Lactation‡
Barley	350 (200-500)	200 (100-220)	200 (100-370)	450 (290-500)	200 (200-200)
Sorghum	300 (0-430)	100 (0-100)	200 (0-400)	190 (100-460)	100 (80-150)
Wheat	0 (0-140)	320 (270-450)	250 (0-430)	100 (0-230)	450 (300-490)
Mill run	200 (150-200)	120 (100-160)	120 (100-200)	0	0
Chickpea	0	0	0	100 (100-100)	50 (0-100)
Vegetable oils	25 (10-27)	25 (15-37)	16 (10-28)	25 (0-50)	15 (7-18)
Canola meal	60 (50-120)	50 (0-120)	60 (40-90)	70 (0-120)	75 (60-100)
Soybean meal	0	120 (60-130)	85 (55-90)	0	30 (0-40)
Meat meal	25 (15-45)	25 (15-50)	30 (20-60)	10 (10-15)	25 (15-50)
Alfalfa crumble	10 (0-12)	10 (6-12)	10 (6-12)	25 (25-25)	15 (12-18)

* Portions of salt, mycotoxin adsorptive product, synthetic amino acids, and mineral premix were added to all diets in standard amounts, each less than 5 kg/metric ton.
† Feed mill A1 supplied farm A (affected) with 11 formulations between 2017 and 2019. Feed mill B1 supplied farm B (unaffected) with 8 formulations over the same time.
‡ Lactation diets were analyzed for mycotoxin and phytoestrogen content.

week. Typical clinical signs were vulval tumefaction (red, swollen, "glassy" vulvas; Figure 4) and failure of proper mammary development noted upon entry to the farrowing area. This failure of mammary development generally resolved within 4 days after farrowing. Approximately 5% of sows on farm A showed estrus behaviour at 18 to 24 days after farrowing. These behaviours included chomping and restlessness, pricked ears, and clear vaginal discharge. The wean-to-service interval was noticeably delayed on farm A (Figure 3) with 7% to 14% of sows showing estrus behaviour 15 to 20 days post weaning. Intermittently, vulva reddening and swelling was observed in female piglets (born on farm A in May 2018) at birth until 5 days of age. None of these findings were noted on farm B; the pigs' genetic origin and farm management procedures, including breeding, data collection, operating, staff training, and auditing procedures, were considered identical.

Phytoestrogenic typing

Analysis of compound feeds derived from feed mill A1 and consumed by females on farm A before, during, and after lactation showed high levels (up to 55,977 µg/kg) of several isoflavonoids, including genistin, glycitin, and daidzin, (Table 2). Scrutiny of dietary ingredients in the affected and unaffected farms (Table 1) indicated that the dietary presence of these isoflavonoids was associated with one source of soybean meal component at feed mill A1, derived from a batch imported from Argentina by a major global feed commodity group and held in a bulk silo. This soybean batch was used throughout the testing period in 2018. Repeated testing (10 occasions) of feed on farms A and B indicated 23 known mycotoxins, including zearalenone, remained below detectable levels or within reference ranges for no effect (Table 2). A change of soybean materials in feed mill A1 was instituted at the end of the study period (September 2019) and the clinical syndrome then dissipated.

Discussion

In this case study, we identified the presence of clinical hyperestrogenism in a proportion of breeding females on an affected farm with the presence of isoflavonoids in specific lactation and wean-to-service diets. These isoflavonoids were apparently derived from one source of soybean meal and were not present to the same extent in the farm B diets. Isoflavonoids are not known to be present in cereals or major dietary components of pig diets, other than soybean meal. The clinical signs noted in affected breeding animals included vulval tumefaction, mammary gland dysfunction, and various signs of infertility, such as more nonproductive days, presumably due to estrogenic effects on the ovary and uterus. These signs closely mimicked those seen in hyperestrogenism syndrome

Figure 1: A) Conception, B) pregnancy, and C) farrowing rates on farms A (affected) and B (unaffected).

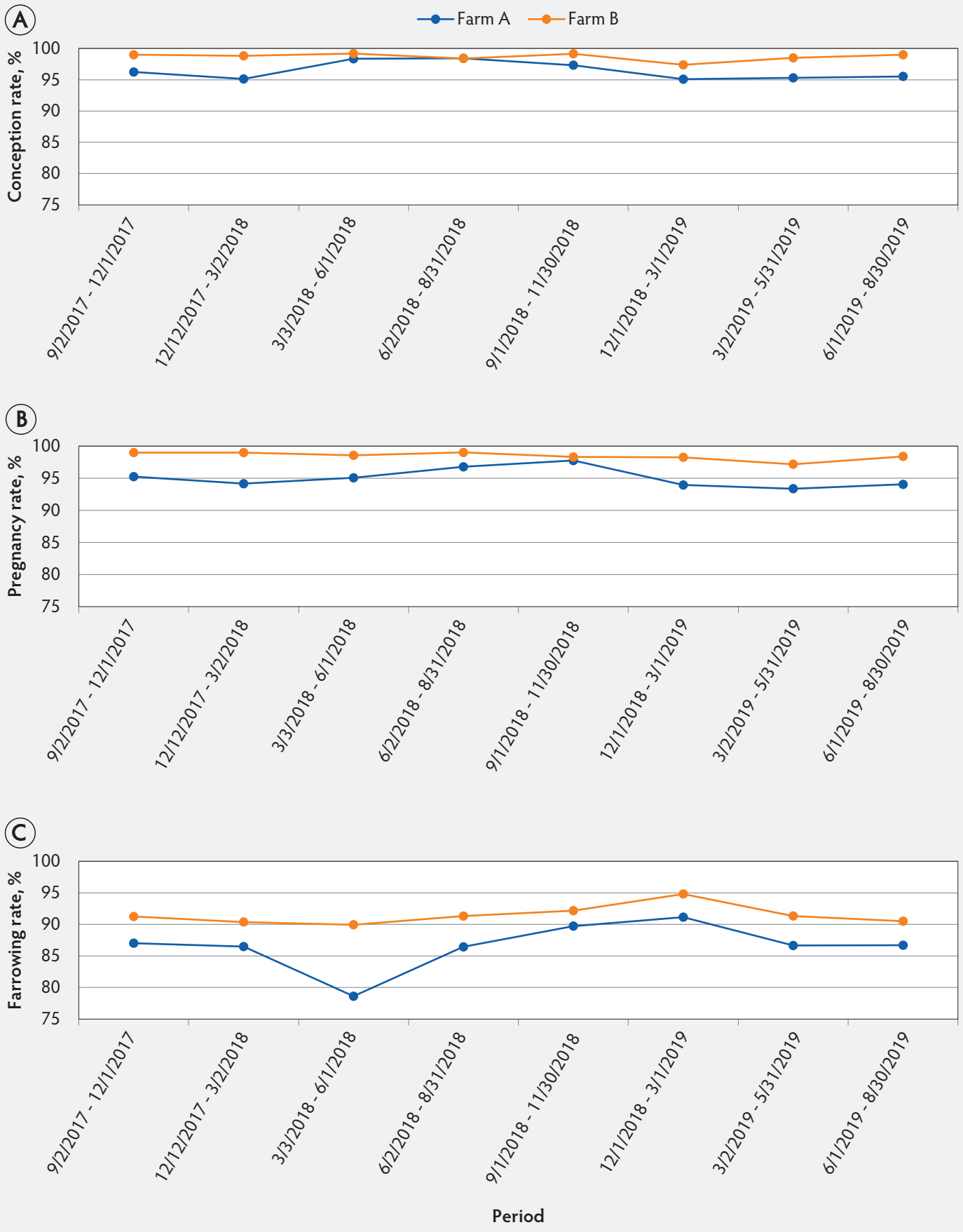
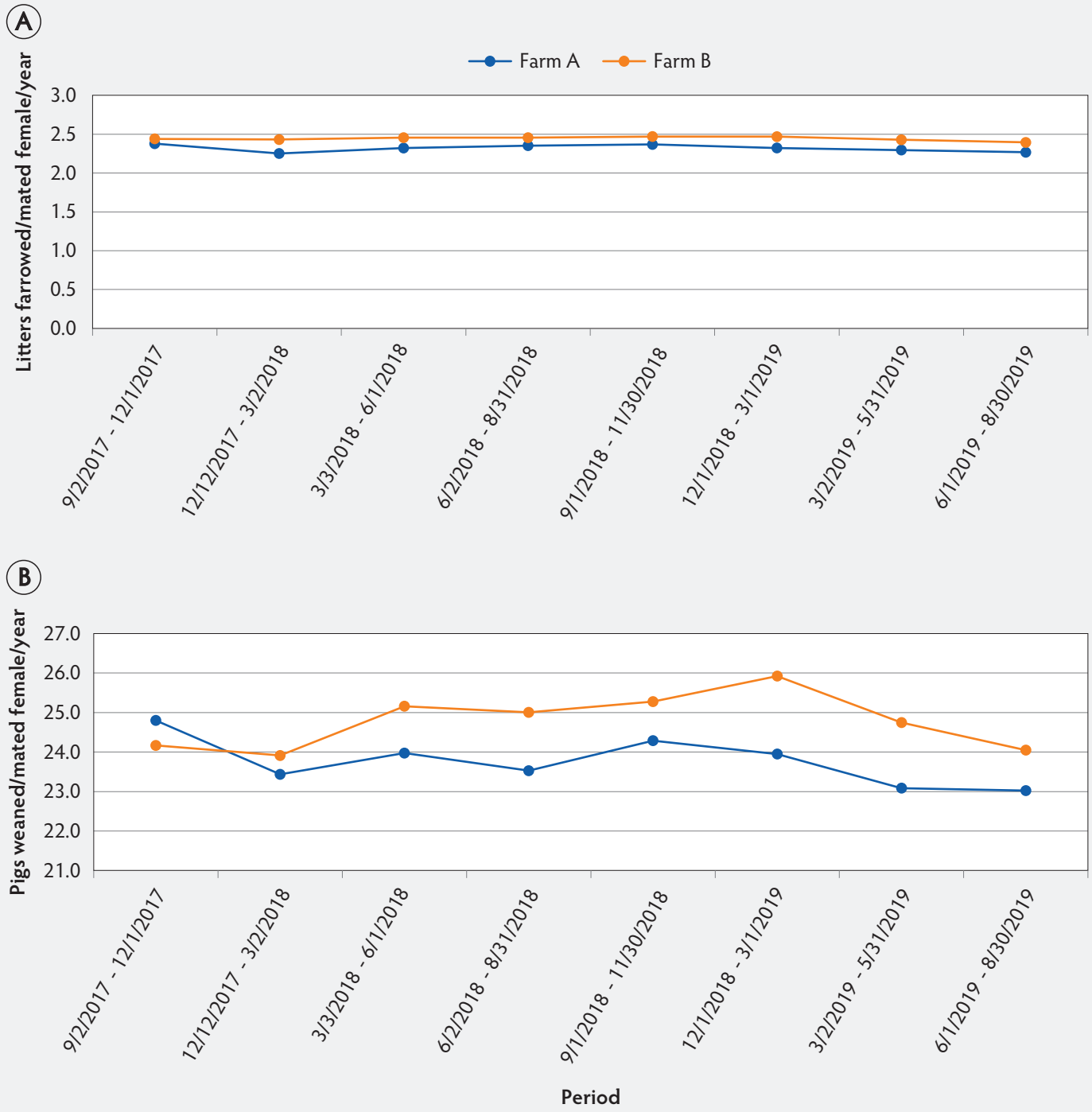


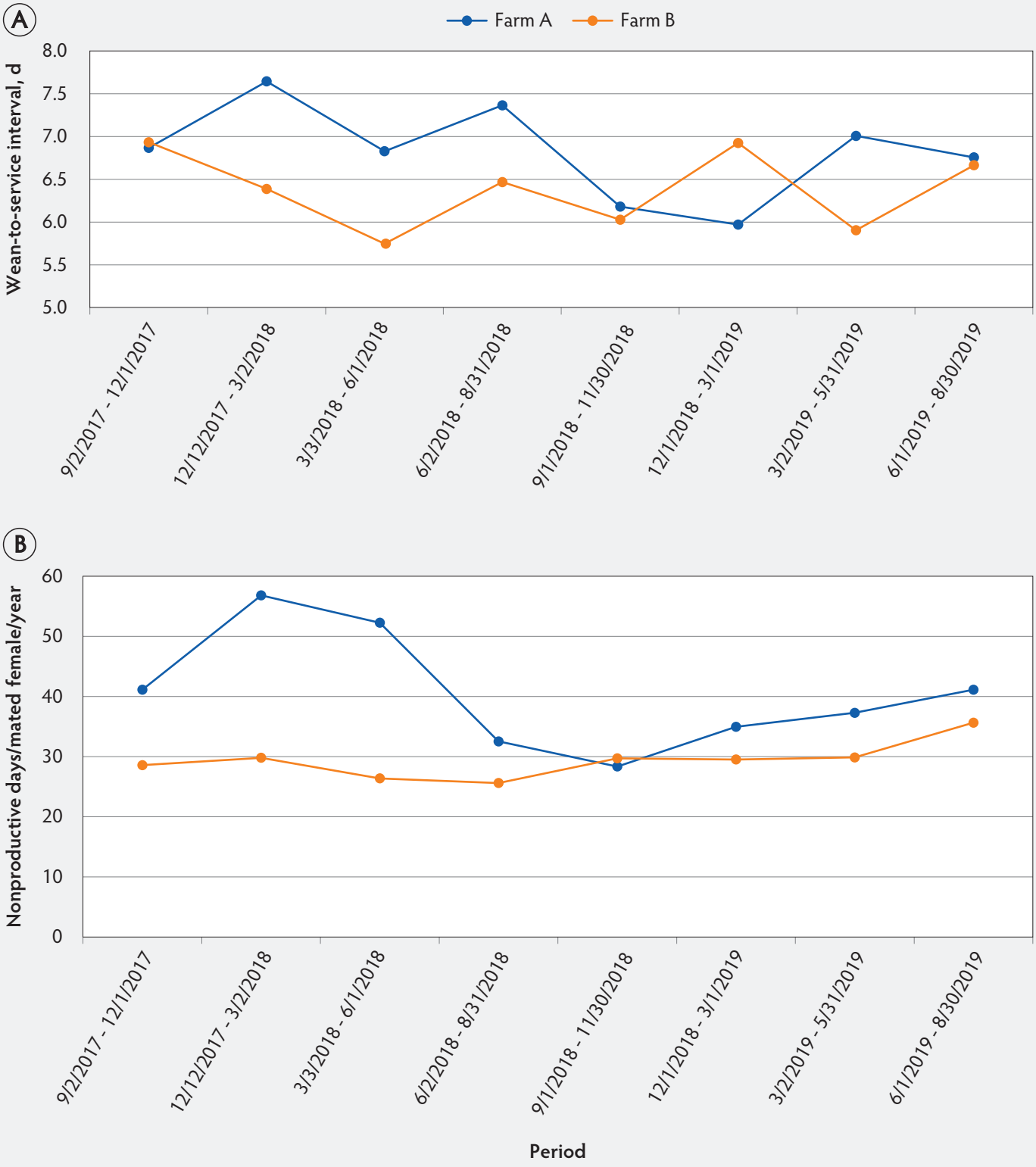
Figure 2: A) Litters farrowed per mated female per year and B) pigs weaned per sow per year on farms A (affected) and B (unaffected).



due to zearalenone toxicosis,[1] but analysis of feed for this and other mycotoxins was consistently negative and constant use of commercial mycotoxin binders in the farm diets did not alleviate the syndrome.

Previous studies of phytoestrogens in pigs have been largely limited to *in vitro* and intentional challenge exposure studies.[7,8] This case study documents the occurrence of hyperestrogenism associated with an oral intake of phytoestrogenic isoflavonoids in commercial farm pigs. The limitations of the case study include that the side-by-side comparison of breeding parameters and feed investigations were only possible on this farm system, rather than all regional pig farms experiencing similar clinical signs. The activity of the isoflavonoids detected in the diets, particularly genistin and daidzin, are well-documented as causes of hyperestrogenism when present in the diet of laboratory animals and other mammals.[3,4] In contrast to mycotoxin testing, the testing of pig feeds for phytoestrogens by HPLC has limited availability and is not widely conducted. Phytoestrogenic isoflavonoids and mycotoxins are both potent stimulators of ERα and ERβ.

Figure 3: A) Wean-to-service interval and B) nonproductive days per mated female per year on farms A (affected) and B (unaffected).



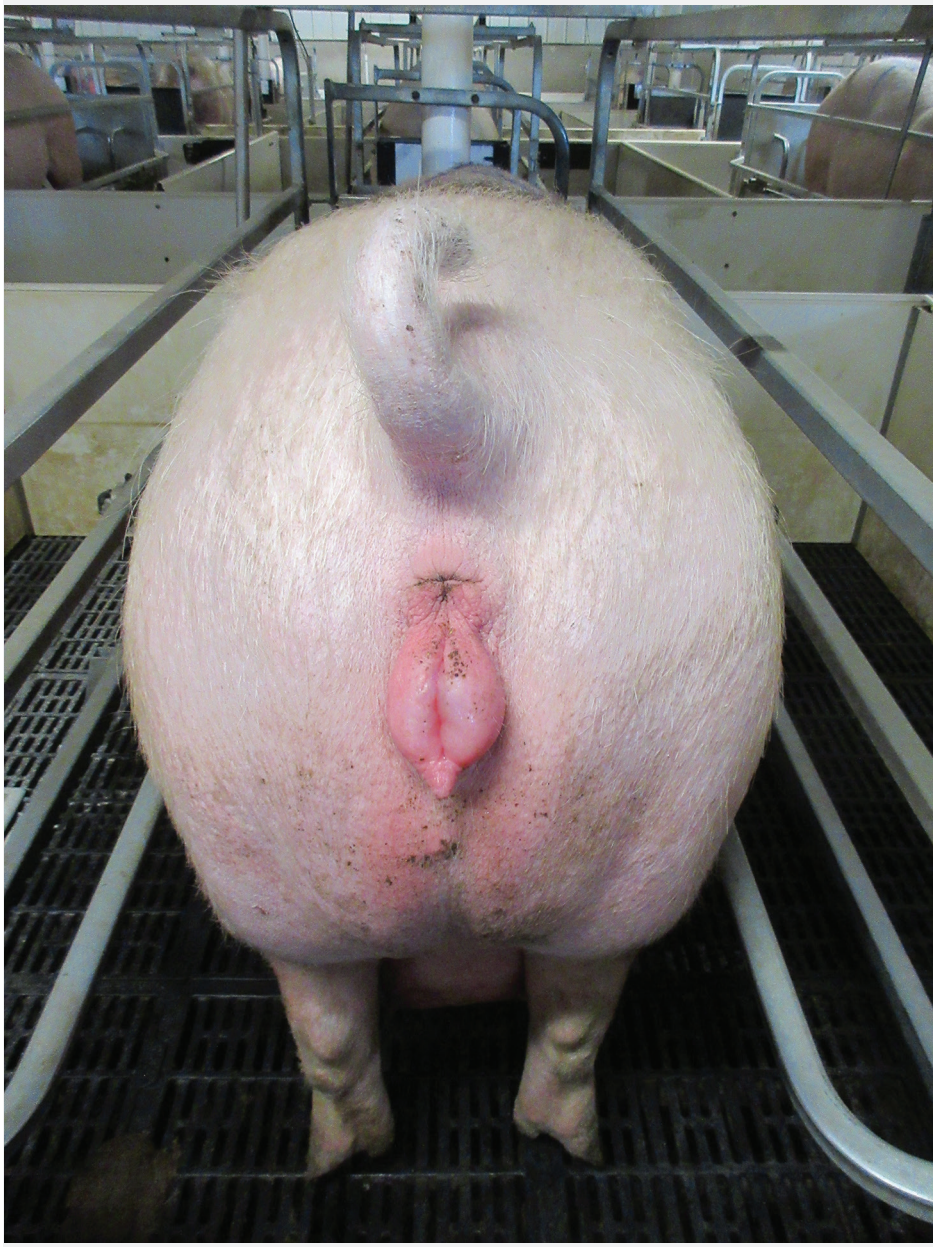
Because no myco-estrogens were detected in the pig feeds in this case study, we therefore considered the isoflavonoids to be involved in the hyperestrogenism syndrome in these sows.

Isoflavonoids occur as phytoestrogenic components of soybean cultivars and are particularly abundant in its growing leaves and roots.[5] The commercial preparation of batches of soybean meal can incorporate approximately 20% of so-called soybean trash, which usually includes leaf and other non-bean components.[10] It is possible that the particular batch of soybean meal used during this case study contained a noticeable quantity of such soybean trash. The aggregation of soybean batches from a variety of in-country sources into this commercial soybean meal, did not allow more specific source identification. Corn and soybean ingredients are used to a lesser extent in feed mill preparation of pig diets in Europe, Asia, and Oceania compared to American diets due to transportation costs. The percentage of soybean meal within suspect diets at feed mill A1 was below standard inclusion rates for some American pig diets. Unlike mycotoxin testing, the testing of soybean meal and other ingredients for phytoestrogens is not a routine practice. Unlike established mycotoxin inhibitor usage, there is limited availability of products that inhibit dietary phytoestrogens. It is therefore suggested that future clinical cases of hyperestrogenism in pigs be investigated for these two possible sources of endocrine disruptors.

Clinical outbreaks of hyperestrogenism have also occurred in housed rodents unintentionally fed commercial diets containing soybeans with high levels of isoflavonoids.[4] Measurement of the isoflavonoid levels in these commercial rodent diets derived from suspect soybean ingredient materials indicated that clinical signs could occur with dietary levels of isoflavonoids in the order of 1000 to 24,000 μg/kg of feed,[4] which were similar to or less than the levels of the isoflavonoids noted in the suspect pig diets in this case study.

Isoflavonoids are known to be absorbed and distributed quickly to the reproductive organs after oral ingestion.[3,7] In this case study, we therefore associated the intake of suspect soybean meal in lactation diets and subsequent postweaning sow diets with onset of hyperestrogenism signs of infertility, particularly noticeable in the wean-to-service phase.

Figure 4: Typical vulva tumefaction noted in affected sow on farm A.



The exact dose of isoflavonoids required to precipitate hyperestrogenism in sows in a farm setting is not clear from previous studies.[7] A calculation of isoflavonoids present in the analyzed pig diets and a normal 200 kg sow average feed intake of approximately 6 kg/day would tend to indicate that the clinical signs noted in this case study could occur with approximately 1 kg of soybean meal content containing approximately 0.12 kg of isoflavonoids (Table 2) per day, that is 0.6 mg of isoflavonoids per kg of bodyweight. It is reasonable to expect that the severity of signs would be dose dependent.

Implications

Under the conditions of this study:

- Soybean-derived isoflavonoids were associated with hyperestrogenism in sows.
- Clinical signs were vulval tumefaction, mammary gland dysfunction, and infertility.

Acknowledgments

We thank the Biomin Inc staff for assistance in organizing the excellent laboratory analyses. We also thank the diligent farm managers for the original pig performance data collection.

Table 2: Mycotoxin and phytoestrogen analysis of sow diets on farm A (affected) and farm B (unaffected)

	Farm A Lactation diet	Farm B Lactation diet
Mycotoxin,*µg/kg		
T-2 toxin	1.86	1.90
Fumonisin B-4	2.44	2.50
Zearalenone	ND	ND
Phytoestrogen, µg/kg		
Daidzein	1045	ND
Daidzin	53,658	ND
Genistein	1733	ND
Genistin	55,977	ND
Glycitein	328	ND
Glycitin	12,713	ND

* Twenty other mycotoxins were analyzed but below the limit of detection including aflatoxins B1, B2, G1, and G2, fumonisin B1, B2, and B3, ochratoxin, nivalenol, deoxynivalenol, 3-acetyl deoxynivalenol, 15-acetyl deoxynivalenol, HT-2 toxin, fusarenon X, neosolaniol, deacetoxyscirpenol, enniatin A1, B, and B1, and ergot alkaloid group.
ND = below the limit of detection.

Conflict of interest

None reported.

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National Pork Board launches AgView as new platform for managing health threats such as African swine fever

The Pork Checkoff announces the launch of AgView – an online animal health database and dashboard platform to help producers, veterinarians, and state and federal animal health officials communicate and make real-time decisions.

Dr Patrick Webb, director of swine health for the National Pork Board, says that AgView, which is being tested and refined now, will be a user-friendly, valuable tool for sharing important animal health information with key collaborators. Phase one of AgView's development will allow pork producers compliant with the Secure Pork Supply plan to share data in a rapid, efficient, and secure way, making it easy to visualize what is needed for risk-based decision-making.

The real game changer will be further development of AgView to provide a more robust nationwide system to help producers analyze data and make decisions to improve swine health and production. AgView will help facilitate this with a user-friendly interface and encrypted cloud-based data security.

In a swine health incident, AgView's new capabilities will help provide state animal health officials with data they will need in the first 72 hours and beyond. This includes a geospatial map of farms, animal movement, and laboratory results that will help determine outbreak locations, the extent of its spread, and subsequent zoning decisions that will affect animal movement.

To prepare for AgView, the National Pork Board is encouraging producers to learn how they can participate in the Secure Pork Supply plan now and begin using AgView as well.

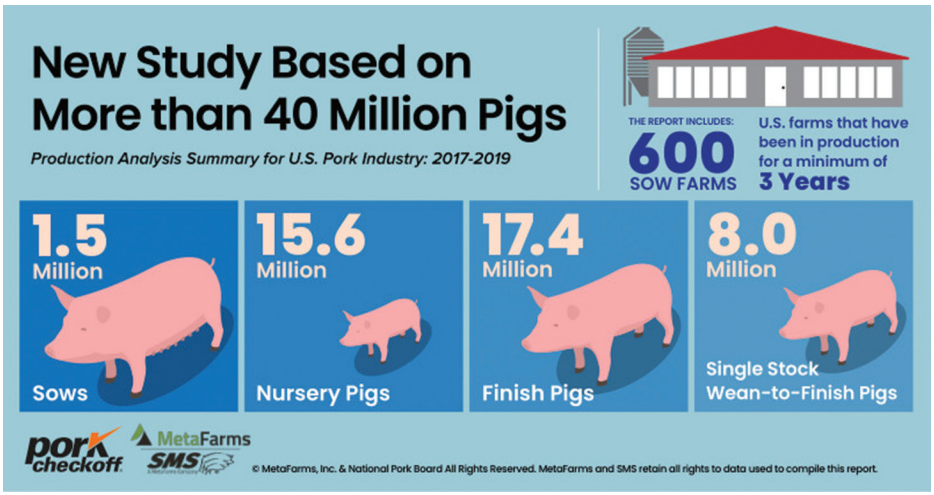
For more information, an AgView demonstration, or questions, contact Dr Patrick Webb at **pwebb@pork.org**, Dr Dave Pyburn at **dpyburn@pork.org**, or go to **pork.org/agview**.

New report: pork industry makes gains in sustainability

As America's pig farmers continue to fight back from the negative impact of COVID-19 and the ups and downs of markets and bad weather, a recent study released by the National Pork Board, *Production Analysis Summary for US Pork Industry: 2017-2019*, shows that America's pig farmers continue to make strides in overall sustainability by being more efficient every day.

The 15-page report, prepared by Minnesota-based MetaFarms and its subsidiary Swine Management Services, looked at sow, nursery, finish, and wean-to-finish data over a three-year period. The results reconfirmed long-term trends of increasing efficiency, which has the additional benefit of reducing production costs.

For more information, contact Dr Chris Hostetler at **CHostetler@pork.org** or find the full report at **library.pork.org/media/**.



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Pharmgate ANIMAL HEALTH

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Nominate exceptional colleagues for AASV awards

Thank you! Well done! We often take many things for granted. It is time to step up to the plate and thank an AASV member who has done so much for our AASV association and the swine industry. Please take the time to nominate deserving members. Now is the time! The AASV Awards Committee would like your help in identifying members who are well deserving of this public recognition. We would love to hear from you if you have nominations for the following five awards to be presented at the AASV Annual Meeting.

Howard Dunne Memorial Award – Given annually to an AASV member who has made a significant contribution and rendered outstanding service to the AASV and the swine industry.

Meritorious Service Award – Given annually to an individual who has consistently given time and effort to the association in the area of service to the AASV members, AASV officers, and the AASV staff.

Swine Practitioner of the Year – Given annually to the swine practitioner (AASV member) who has demonstrated an unusual degree of proficiency in the delivery of veterinary service to his or her clients.

Technical Services/Allied Industry Veterinarian of the Year – Given annually to the technical services or allied industry veterinarian who has demonstrated an unusual degree of proficiency and effectiveness in the delivery of veterinary service to his or her company and its clients as well as given tirelessly in service to the AASV and the swine industry.

Young Swine Veterinarian of the Year – Given annually to a swine veterinarian who is an AASV member, 5 years or less post-graduation, who has demonstrated the ideals of exemplary service and proficiency early in his or her career. DVM/VMD graduates of 2015 through 2019 will be considered for the 2021 award.

Nominations are due December 15th. The nomination letter should specify the award and cite the qualifications of the candidate for the award. Submit to: AASV, 830 26th Street, Perry, Iowa 50220, email: **aasv@aasv.org**.

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AASV Annual Meeting

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February 27 - March 2, 2021

aasv.org/annmtg

The AASV is moving forward with plans for the 2021 AASV Annual Meeting. Guidelines associated with COVID-19 may necessitate changes yet to be determined. Please check aasv.org/annmtg frequently for updated information and revisions.

2021 ANNUAL MEETING PROGRAM

AASV'S 52nd ANNUAL MEETING

February 27 – March 2, 2021

NAVIGATING THE FUTURE . . . *Together*

SATURDAY, FEBRUARY 27

Pre-conference seminars

1:00 PM – 5:00 PM
(except for Seminar #5: 12:00 PM – 5:00 PM)

Seminar #1	We're All in This Together (Practice Tips) *Melissa Billing, chair*
Seminar #2	Navigating Leadership: Becoming and Being a Vet CEO *Sarah Probst Miller, chair*
Seminar #3	Precision Swine Health and Production Management *Daniel Linhares, chair*
Seminar #4	The Pathogens that Ail Us *Brent Pepin, chair*
Seminar #5	Operation Main Street Speaker Training *Al Eidson, chair*
Seminar #6	Unthinkable to Actionable to Teachable to Learnable: Managing Swine Production through a Pandemic *Alex Hintz, chair*

SUNDAY, FEBRUARY 28

Pre-conference seminars

8:00 AM – 12:00 PM

Seminar #7	Boar Studs and Herd Breeding Performance *Gary Althouse, chair*
Seminar #8	Raising Pigs for Dummies (Keep Them Alive!) *Kevin Eggers, chair*
Seminar #9	Mass Depopulation Strategies *Clayton Johnson and Patrick Webb, co-chairs*
Seminar #10	Swine Medicine for Students *Jeremy Pittman and Angela Supple, co-chairs*
Seminar #11	Building Expertise, #ImNewAtThisPart2 *Kate O'Brien, chair*

Research Topics

8:00 AM – 12:00 PM
Session chair: Chris Rademacher

8:00 AM	Detection and diagnostic trends of five swine endemic bacterial pathogens (2010-2019) *Ana Paula Poeta Silva*
8:15 AM	Replication of clinical *Streptococcus equi* subspecies zooepidemicus disease in sows and feeder pigs *Samantha Hau*
8:30 AM	Antibiotic susceptibility testing of *Mycoplasma hyopneumoniae* and *Mycoplasma hyorhinis* field isolates from the United States *Beatriz Garcia-Morante*
8:45 AM	Effect of tulathromycin treatment on *Mycoplasma hyopneumoniae* detection and infectious potential *Alyssa Betlach*
9:00 AM	Estimation of pool sensitivity for detection of *Mycoplasma hyopneumoniae* by PCR using deep tracheal catheter field samples *Amanda Sponheim*
9:15 AM	Distribution of viremic piglets in farrowing rooms violates the homogeneous population assumption - implications for PRRSV detection? *Marcelo Almeida*

9:30 AM	Determining the source of *Serratia* and other bacteria in boar semen *Darwin Reicks*
9:45 AM	REFRESHMENT BREAK
10:15 AM	Active environmental surveillance of SARS-CoV-2 in midwestern meatpacking plants *Suzanna Storms*
10:30 AM	Experimental intravenous, intratracheal, and intranasal inoculation of swine with SARS-CoV-2 *Alexandra Buckley*
10:45 AM	Impacts of African swine fever in Iowa and the United States *Dermot Hayes*
11:00 AM	A comparison of active surveillance protocols to support pre-movement guidelines for African swine fever *Michelle Farr*
11:15 AM	Active regional surveillance for early detection of exotic/emerging pathogens of swine: a comparison of statistical approaches for selecting farms to be sampled *Ting-Yu Cheng*
11:30 AM	Use of two demonstration projects to evaluate viral survival in feed *Scott Dee*
11:45 AM	Use of a demonstration project to test the effect of extended storage on viral survival in feed: proof of concept *Scott Dee*
12:00 PM	Session concludes

Poster session: Veterinary Students, Research Topics, and Industrial Partners

12:00 PM – 5:00 PM

Poster authors present from 12:00 PM to 1:00 PM
Poster display continues on Monday, 9:00 AM to 5:00 PM

Concurrent sessions

1:00 PM – 5:15 PM

Session #1	**Student Seminar** *Andrew Bowman and Perle Zhitnitskiy, co-chairs*
Session #2	**Industrial Partners** *Jessica Seate and Nathan Winkelman, co-chairs*
Session #3	**Industrial Partners** *Jessica Davenport and Michael Pierdon, co-chairs*
Session #4	**Industrial Partners** *Kate Dion and Michael Senn, co-chairs*

MONDAY, MARCH 1

General Session
Navigating the Future … Together

8:00 AM – 12:30 PM
Program and Session chair: Mary Battrell

8:00 AM	**Howard Dunne Memorial Lecture** Navigating the future together *Jerome Geiger*
9:00 AM	**Alex Hogg Memorial Lecture** Enhancing your brand: the value of lifelong learning, continuing education, and teaching to the swine industry *Jeremy Pittman*
10:00 AM	REFRESHMENT BREAK
10:30 AM	Farmers under fire *Andy Curliss*
11:15 AM	The 2050 challenge: satisfying the global demand for animal protein without depleting our natural resources *Frank Mitloehner*
12:00 PM	Your right and responsibility to be well *Elizabeth Strand*
12:30 PM	LUNCHEON

Concurrent Session #1: The Same Old Bugs; Not the Same Old Toolkit

2:00 PM – 5:30 PM
Session chair: Rebecca Robbins

2:00 PM	Preparing for a low-zinc world *Mike Tokach*
2:45 PM	Porcine reproductive and respiratory syndrome (PRRS) clamp: diagnostic tools to distinguish between wild-type and vaccine strains of PRRS virus *Phil Gauger*
3:30 PM	REFRESHMENT BREAK
4:00 PM	What can we learn from a porcine reproductive and respiratory syndrome whole genome sequence? *Albert Rovira*
4:45 PM	Friend or foe: what next generation sequencing can tell you about the endemic agents in your herd *Maria Clavijo*
5:30 PM	Session concludes

Concurrent Session #2: Welfare and the Swine Veterinarian

2:00 PM – 5:30 PM
Session chair: Meghann Pierdon

2:00 PM	Dealing with activists: managing from a practitioner perspective, proactive versus reactive – A case comparison of 2 reactions and 2 paths to resolution *Sarah Probst Miller*
2:30 PM	California Proposition 12: what are the specifics and how can producers manage? *Tom Parsons*
3:00 PM	Lameness: relationship to longevity and pain *John Deen*
3:30 PM	REFRESHMENT BREAK
4:00 PM	Emotion and cognition in pigs: what does the science tell us? *Kristina Horback*
4:30 PM	Practical solutions for enrichment *Meghann Pierdon*
5:00 PM	Individual animal euthanasia for baby piglets and large sows and boars: new research and techniques *Monique Pairis-Garcia*
5:30 PM	Session concludes

Concurrent Session #3: African Swine Fever

2:00 PM – 5:30 PM
Session chair: Patrick Webb

2:00 PM	Federal efforts to reduce the risk of African swine fever introduction into the United States *Jack Shere*
2:15 PM	Veterinary and producer efforts to reduce the risk of African swine fever in the United States swine herd *Wesley Lyons*
2:30 PM	Gaps that exist to prevent African swine fever introduction into the United States and how can we address them *Emily Byers*
2:45 PM	What is new in the United States Department of Agriculture African swine fever Red Book that swine veterinarians need to know *Jack Shere*
3:00 PM	What the state veterinarians' African swine fever working group has done to help improve preparedness *Mike Neault*
3:15 PM	What the pork industry has done to prepare for an African swine fever outbreak *Paul Sundberg*
3:30 PM	REFRESHMENT BREAK
4:00 PM	Testing expectations and protocols in control areas and free areas *Jack Shere*
4:15 PM	Veterinary perspective on managing herds in the control area *Marisa Rotolo*

4:30 PM	Packer response to an African swine fever outbreak *Tiffany Lee*
4:45 PM	What will it take to get back into business and trade: industry perspective *Russ Nugent*
5:00 PM	What is needed to get trade going again and realistic timelines *Jack Shere*
5:15 PM	What if we must learn to live with African swine fever? *Keith Erlandson*
5:30 PM	Session concludes

TUESDAY, MARCH 2
General Session: COVID-19 Lessons Learned

8:00 AM – 12:00 PM
Session chair: Paul Yeske

8:00 AM	Economic impact of COVID-19 on macro and swine economies *Lee Schulz*
9:00 AM	Lessons learned from plant closures, testing employees, and modeling outbreaks *Kimberly VanderWaal*
9:45 AM	REFRESHMENT BREAK
10:15 AM	What has human medicine learned from the COVID-19 outbreak? *Jeremy Cauwels*
11:00 AM	How to handle COVID-19 down on the farm *Larry Coleman*
11:30 AM	United States Department of Agriculture response to COVID-19; what did we learn to be better prepared? *Jack Shere*
12:00 PM	Session and meeting concludes

The AASV is moving forward with plans for the 2021 AASV Annual Meeting with the understanding that guidelines associated with COVID-19 may necessitate changes yet to be determined. Please check **aasv.org/annmtg** regularly for updated information and revisions.

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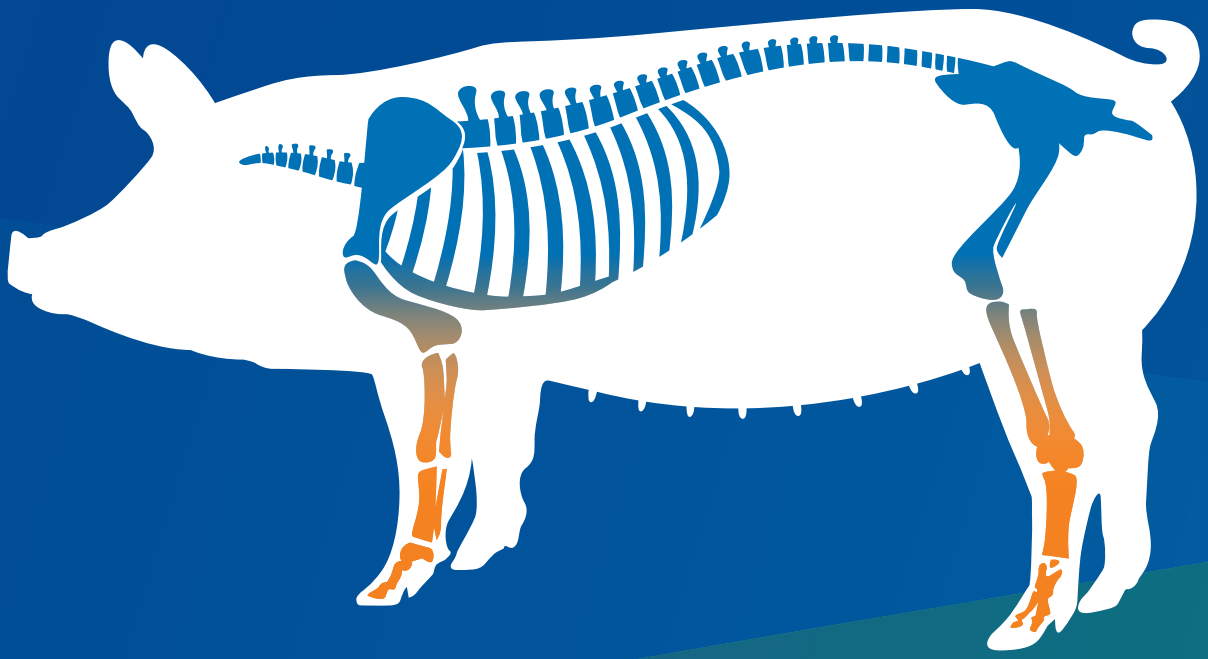

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FOUNDATION NEWS

Debt relief scholarship program expanded, renamed to honor donors

The AASV Foundation has increased the number of student debt-relief scholarships to be awarded in 2021. Three $5000 scholarships will be provided to early-career swine practitioners through the "Dr Conrad and Judy Schmidt Family Student Debt Relief Endowment," which was renamed to honor the donors who established the scholarship program.

The scholarships are available to AASV members engaged in private practice who are between 2 and 5 years post graduation from veterinary school (2016-2018) and who carry a significant student debt burden.

The scholarship program was initiated two years ago with a $110,000 contribution to the foundation by the Conrad Schmidt and Family Endowment. Dr Schmidt, a charter member of AASV, explained, "Together, Judy and I noticed that many new DVM graduates interested in swine medicine begin their professional life with heavy educational debt obligations. It is our desire to help AASV members who have dedicated their professional skills to swine herd health and production."

Since then, the number of applicants for the scholarship demonstrated a need to expand the program to support more early-career swine veterinarians who are carrying a heavy student debt load.

Applications are being accepted through January 31 for the scholarships to be awarded during the 2021 AASV Annual Meeting. The application form is available at **aasv.org/foundation/debtrelief.php**. The following criteria will be used to select the scholarship recipients:

1. Joined AASV as a student enrolled in an AVMA-recognized college of veterinary medicine
2. Attended the AASV Annual Meeting as a student
3. Maintained continuous membership in AASV since graduation from veterinary school
4. Is at least 2 years and at most 5 years post graduation from veterinary school (2016, 2017, 2018 DVM/VMD graduates)
5. Has been engaged in private veterinary practice, 50% or more devoted to swine, providing on-farm service directly to independent pork producers. Veterinarians who work for production companies, pharmaceutical companies, or universities are not eligible for the scholarship.
6. Has a significant student debt burden

Previous recipients of the scholarship are not eligible to reapply. For more information, contact the AASV Foundation: **aasv@aasv.org**, 515-465-5255.

$5000 scholarships available to second- and third-year veterinary students

For the sixth year, the AASV Foundation and Merck Animal Health are pleased to offer the AASVF-Merck Animal Health Veterinary Student Scholarship Program. Ten $5000 scholarships will be awarded to sophomore and junior veterinary students in 2021. The program seeks to identify future swine veterinarians and assist with their educational expenses. Applications are due December 31, 2020 for scholarships that will be announced during the 2021 AASV Annual Meeting.

Second- and third-year veterinary students enrolled in AVMA-accredited or -recognized colleges of veterinary medicine in the United States, Canada, Mexico, South America, or the Caribbean Islands are eligible to apply. All applicants must be current (2020-2021) student members of AASV. Students who have previously been awarded one of the scholarships from AASV or the American Association of Bovine Practitioners are not eligible to apply.

To apply, students submit a resume and the name of a faculty member or AASV member to serve as a reference, along with written answers to four essay questions. The application and instructions are available at **aasv.org/foundation/2021/AASVF-Merck-Scholarships.php**.

A committee of four conducts the selection process. Two AASV Foundation board members and two AASV members-at-large rank the applicants by scoring their past and current activities, level of interest in swine veterinary medicine, future career plans, and financial need. The scholarship recipients will be announced during the 2021 AASV Annual Meeting, and the scholarship funds will be disbursed after the conference.

The AASVF-Merck Animal Health Veterinary Student Scholarship Program is part of how Merck Animal Health and the AASV Foundation fulfill a shared mission of "supporting the development and scholarship of students and veterinarians." For more information on scholarships and other AASV Foundation programs, see **aasv.org/foundation**.

AASV Foundation news continued on page 323

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AASV Foundation news continued from page 321

Golfers support AASV Foundation, raise $13,850

A beautiful day greeted golfers at the 2020 AASV Foundation Golf Outing, held August 20 at Veenker Memorial Golf Course in Ames, Iowa. Despite changes necessitated by coronavirus disease 2019 (COVID-19), the event benefited from an excellent turnout of golfers and strong support from sponsors, raising $13,850 for the foundation. The winning team, hosted by Pharmgate Animal Health, included two members of last year's top team: Jeff Okones and Matt Sexton, who were joined this year by Ralph Wilson and Tim Henry. Their overall team score for the best-ball format was 15 under par, 6 strokes ahead of the runners-up: Mark Weaver, Ross Brown, Chris Rademacher, and Chris Sparks, hosted by Cambridge Technologies. The third-place team consisted of 3 individual registrants: Daryl Hammer, Dan Rosener, and Rick Sibbel, who combined their efforts to come in 7 strokes under par.

A total of 56 golfers on 15 teams tested their skills against the challenging course. The golfers also enjoyed a variety of games, contests, and giveaways hosted at the golf holes by sponsors **Aurora Pharmaceutical, GVL, Huvepharma, Insight Wealth Group, Kemin Animal Nutrition & Health, National Pork Producers Council, Pharmgate Animal Health, Phibro Animal Health, and Topigs Norsvin USA**.

Box lunches accompanied by sleeves of golf balls were provided by **APC** and beverages were sponsored by **Zoetis**. Although COVID-19 restrictions prevented holding the traditional awards dinner to conclude the event, **Boehringer Ingelheim Animal Health** graciously maintained their financial support to benefit the foundation.

Photos courtesy of Insight Wealth Group

The team hosted by Pharmgate Animal Health took top honors at this years' AASV Foundation Golf Outing. Left to right: Ralph Wilson, Jeff Okones, Tim Henry, Matt Sexton.

Golfers were able to enter scores and monitor the event leaderboard on their phones throughout the afternoon using `scrolf.com`. After the event, the foundation announced team and individual contest winners by email, and prizes were mailed to the winners.

Sincere thanks are extended to coordinator Dr Josh Ellingson for his work to ensure a fun outing for participants and a successful fundraiser for the foundation. Proceeds from the event support a variety of foundation programs, including scholarships, research grants, travel stipends for veterinary students to attend the annual meeting, swine externship grants, and more.

And the winners are:

First flight

First place team, hosted by Pharmgate Animal Health: Tim Henry, Jeff Okones, Matt Sexton, and Ralph Wilson

Second place team, hosted by Cambridge Technologies: Ross Brown, Chris Rademacher, Chris Sparks, and Mark Weaver

Third place team, individual registrants: Daryl Hammer, Dan Rosener, and Rick Sibbel

THANK YOU - WE ARE GRATEFUL FOR YOUR SUPPORT!

The following companies very generously "chipped in" to underwrite the cost of the golf outing, enabling the proceeds to benefit the AASV Foundation.

DINNER SPONSOR:
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LUNCH SPONSOR:
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BEVERAGE SPONSOR:
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GOLF HOLE SPONSORS

• Aurora Pharmaceutical • GVL• Huvepharma • Insight Wealth Group • Kemin Animal Nutrition & Health • National Pork Producers Council • Pharmgate Animal Health • Phibro Animal Health • Topigs Norsvin USA

Second flight

First place team, hosted by Zoetis: Josh Ellingson, Trey Kellner, Steve Schmitz, and Nick Weis

Second place team, hosted by National Pork Producers Council: Tyler Bettin, Tom Floy, Doug Fricke, and Derrick Sleezer

Third place team, hosted by Iowa State University Veterinary Diagnostic Laboratory: Justin Brown, Eric Burrough, and Drew Magstadt

Third flight

First place team, hosted by Topigs Norsvin USA: Mitch Christensen, Trevor Schwartz, Ethan Spronk, and Amber Stricker

Second place team, hosted by Fast Genetics: Darrell Neuberger, Kent Schwartz, Steve Sornsen, and Jeff Zimmerman

Third place team, hosted by Pharmacosmos: Daniel Boykin, Christine Mainquist-Whigham, and Chris Olsen

Individual contests

Hole #1, **Longest drive:** Austin Putz

Hole #2, **Chip-in raffle** (sponsored by Kemin Animal Nutrition & Health): Darrell Neuberger, Jeff Okones, and Rick Sibbel

Hole #5, **Closest to the pin,** 2nd shot: Drew Magstadt

Hole #7, **Closest to the target drive** (sponsored by Topigs Norsvin USA): Rick Sibbel

Hole #9, **Longest putt** (sponsored by Aurora Pharmaceutical): Mark Weaver

Hole #11, **Closest to the pin** (sponsored by Huvepharma): Matt Sexton

Hole #15, **Closest to the target drive:** Christine Mainquist-Whigham

Hole #15, **Bottle opener putting contest** (sponsored by National Pork Producers Council): Keith Bretey

Hole #18, **Longest putt:** Grant Weaver

Hole #18, **Raffle winner** (sponsored by Pharmgate Animal Health): Amber Stricker

AASV Foundation increases research funding to $100,000

In recognition of the value and need for research with direct application to the swine veterinary profession, the AASV Foundation has increased the amount of funding available for research proposals in 2021 from $60,000 to $100,000.

Proposals are now being accepted. They are due by 12:00 PM Central Time on January 15, 2021 and may request a maximum of $30,000 (US$) per project. The announcement of projects selected for funding will take place during the 2021 AASV Annual Meeting.

Proposed research should fit one of the five action areas stated in the AASV Foundation mission statement (see sidebar).

The instructions for submitting proposals are available on the AASV Foundation website at **www.aasv.org/foundation/2021/research.php**.

A panel of AASV members will evaluate and select proposals for funding, based on the following scoring system:

- Potential benefit to swine veterinarians/swine industry (40 points)
- Probability of success within timeline (35 points)
- Scientific/investigative quality (15 points)
- Budget justification (5 points)
- Originality (5 points)

A summary of the research funded by the foundation over the past 14 years is available at **aasv.org/foundation/research.htm**.

For more information, or to submit a proposal: AASV Foundation, 830 26th Street Perry, IA 50220-2328, 515-465-5255, **aasv@aasv.org**

AASV Foundation Mission

The mission of the American Association of Swine Veterinarians Foundation is to empower swine veterinarians to achieve a higher level of personal and professional effectiveness by:

- enhancing the image of the swine veterinary profession,
- supporting the development and scholarship of students and veterinarians interested in the swine industry,
- addressing long-range issues of the profession,
- supporting faculty and promoting excellence in the teaching of swine health and production, and
- funding research with direct application to the profession.

Navigating the future … together!

The events since the last AASV Annual Meeting, themed "2020: A Vision for the Future," demonstrated how quickly the future we envision can turn into something we never could have imagined! Yet those same events have shown us how connected we are, and how much we can accomplish when we work together, even – and perhaps especially – when the future is uncertain. It is fitting that the theme for the 2021 AASV Annual Meeting, and the AASV Foundation fundraising auction, is "Navigating the Future … *Together*."

The AASV Foundation was established in 1988 with a clear "vision for the future." Our predecessors with a vision saw the need and worked *together* to set aside funds for the future – not only for the issues they were aware of in 1988, but also to address the issues of 2020 that they never could have imagined.

Since then, the effort to fulfill the mission of the foundation has continued to expand as we strive to *Ensure our future … Create a legacy*. Here is just a partial list of how our foundation is currently benefiting those engaged in the swine veterinary profession.

The AASV Foundation:

- Administers endowments for the Howard Dunne and Alex Hogg Memorial Lectures
- Administers the Hogg Scholarship for deserving AASV member veterinarians to pursue advanced degrees
- Administers funding for veterinary student scholarships
- Provides funding for AASV members pursuing board certification in the American College of Animal Welfare
- Cosponsors travel stipends for veterinary students to attend the AASV Annual Meeting
- Provides grants to supplement veterinary student swine-related externships
- Administers funding for important research with direct application and benefits to our profession and swine health
- Provides support for the awesome Heritage videos
- Provides tuition support for veterinary students to attend the Swine Medicine Education Center
- Administers and supports the Dr Conrad and Judy Schmidt Family Student Debt Relief Scholarships

While the foundation's level of total endowed funds has grown each year, the ongoing use of funds for our many annual investments in fulfilling the mission requires that we continue to encourage annual gifts. A great way for all members to contribute has been through the live and silent auctions held during the AASV Annual Meeting. The auctions are an integral part of the meeting, thanks to the many donors and, of course, to all of you, the bidders!

Donate auction items by December 1

The Auction Committee is reaching out to potential donors to solicit auction items or cash donations for this year's auction, but don't wait - please contact a member of the committee if you are interested in supporting the auction this year. To ask questions or discuss possibilities, contact one of the committee members listed at **aasv.org/foundation/2021/auctioninfo.php**.

To donate, download the donation form at **aasv.org/foundation/2021/Donationform.pdf** and submit a description and image of your item(s) by **December 1**. Your contribution will be recognized in the auction catalog as well as on the auction website, and your name will appear in the JSHAP full-page spread recognizing our auction item donors. Plus, there is a good chance you may read about your donation in the AASV e-Letter!

Working together, we can navigate the future … whatever it looks like!

AASV Foundation news continued on page 327

SWINE DISEASE MANUAL

5TH EDITION

EJ Neumann, A Ramirez, KJ Schwartz

Fully revised!

An informative reference for students, instructors, practitioners, technicians, producers, and anyone working in the swine industry

Provides a concise overview of bacterial, viral, parasitic, nutritional, and other diseases and syndromes affecting swine

Information for each etiologic agent includes alternate names, definition, occurrence, history, etiology, epidemiology, pathogenesis, clinical signs, lesions, diagnosis, and control

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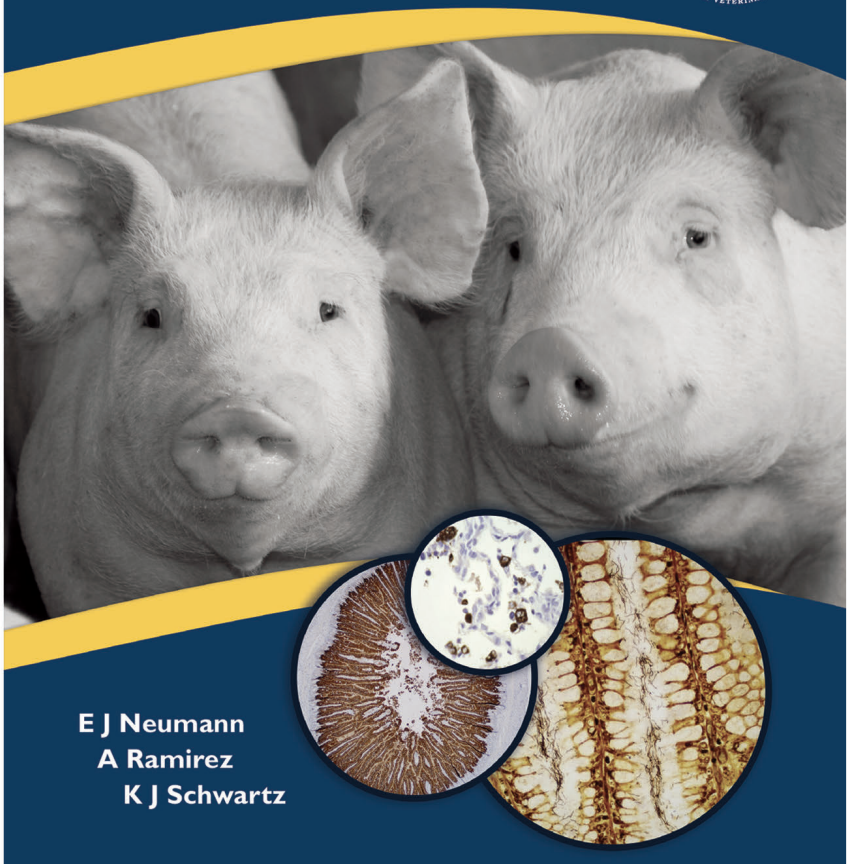

Published by the
American Association of Swine Veterinarians

AASV Foundation news continued from page 325

Hogg Scholarship offers support to practitioners pursuing a graduate degree

The American Association of Swine Veterinarians Foundation is pleased to offer the Hogg Scholarship, established to honor the memory of longtime AASV member and swine industry leader Dr Alex Hogg.

The intent of the scholarship is to assist a swine veterinarian in his or her efforts to return to school for graduate education (resulting in a master's degree or higher) in an academic field of study related to swine health and production. Twelve swine practitioners, recognized at **aasv.org/foundation/hoggscholars.htm**, have been awarded this prestigious scholarship since it was established in 2008.

Applications for the $10,000 scholarship will be accepted until January 31, 2021, and the scholarship recipient will be announced Sunday, February 28 during the 2021 AASV Annual Meeting.

Dr Alex Hogg's career serves as the ideal model for successful applicants. After twenty years in mixed animal practice, Dr Hogg pursued a master's degree in veterinary pathology. He subsequently became Nebraska swine extension veterinarian and professor at the University of Nebraska. Upon "retirement," Dr Hogg capped off his career with his work for MVP Laboratories. Always an enthusiastic learner, at age 75 he graduated from the Executive Veterinary Program offered at the University of Illinois.

The scholarship application requirements are outlined below, and on the AASV website at **http://www.aasv.org/foundation/hoggscholarship.htm**.

Hogg Scholarship Application Requirements

An applicant for the Hogg Scholarship shall have:

1. Three or more years of experience as a swine veterinarian, either in a private practice or in an integrated production setting
2. Five or more years of continuous membership in the American Association of Swine Veterinarians

Applicants are required to submit the following for consideration as a Hogg Scholar:

1. Current curriculum vitae
2. Letter of intent detailing his or her plans for graduate education and future plans for participation and employment within the swine industry
3. Two letters of reference from AASV members attesting to the applicant's qualifications to be a Hogg Scholar

Applications and requests for information may be addressed to: AASV Foundation 830 26th Street, Perry, IA 50220, Tel: 515-465-5255, **aasv@aasv.org**.

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AH0470

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960 ml

tilmicosin phosphate (250 mg/ml tilmicosin)

Aqueous concentrate for oral use in drinking water.
For swine only.
Macrolide Antibiotic.
Do not inject this product. Injection of tilmicosin has been shown to be fatal in swine and non-human primates, and may be fatal in horses and goats.

WARNING

Exposure to tilmicosin in humans has been associated with chest pain, increased heart rate, dizziness, headache, and nausea. Death has been reported following ingestion or injection of tilmicosin.
Avoid ingestion. Avoid direct skin and eye contact. In case of human exposure, call 1-800-722-0987 and consult a physician immediately.
NOTE TO THE PHYSICIAN:
The cardiovascular system is the target of toxicity and should be monitored closely.
The primary cardiac effects are tachycardia and decreased contractility.
Cardiovascular toxicity may be due to calcium channel blockade.
See User Safety Warnings for additional information.

CAUTION: Federal law restricts this drug to use by or on the order of a licensed veterinarian.

Active Drug Ingredient: tilmicosin (as tilmicosin phosphate) 250 mg/ml

Description: Pulmotil is a formulation of the antibiotic tilmicosin. Tilmicosin is produced semi-synthetically and is in the macrolide class of antibiotics. Each milliliter (mL) of Pulmotil aqueous concentrate solution contains 250 mg of tilmicosin.

Indications: For the control of swine respiratory disease associated with *Pasteurella multocida* and *Haemophilus parasuis* in groups of swine in buildings where a respiratory disease outbreak is diagnosed.

For the control of swine respiratory disease associated with *Mycoplasma hyopneumoniae* in the presence of Porcine Reproductive and Respiratory Syndrome Virus (PRRSV) in groups of swine in buildings where a respiratory disease outbreak is diagnosed.

Dosage and Administration: Must be diluted before administration to animals. Include in the drinking water to provide a concentration of 200 mg tilmicosin per liter (200 ppm). One 960 ml bottle is sufficient to medicate 1200 liters (320 gallons) of drinking water for pigs. The medicated water should be administered for (5) five consecutive days.

Use within 24 hours of mixing with water. Do not use rusty containers for medicated water as they may affect product integrity.

When using a water medicating pump with a 1:128 inclusion rate, add 1 bottle (960 ml) of Pulmotil AC per 2.5 gallons of stock solution.

WARNINGS:
USER SAFETY WARNINGS: FOR USE IN ANIMALS ONLY.
NOT FOR HUMAN USE. KEEP OUT OF REACH OF CHILDREN.
SEE BOXED WARNING AND NOTE TO THE PHYSICIAN FOR ADDITIONAL INFORMATION.
Wear overalls, impervious gloves and eye protection when mixing and handling the product. Wash hands after handling the product. Wash affected parts if skin contact occurs. If accidental eye contact occurs, immediately rinse thoroughly with water.
To report suspected adverse events, for technical assistance, or to obtain a Material Safety Data Sheet (MSDS), call 1-800-428-4441.

▶ **RESIDUE WARNING:** Swine intended for human consumption must not be slaughtered within 7 days of the last treatment with this product. ◀

Note to the Physician:
The cardiovascular system is the target of toxicity and should be monitored closely. Cardiovascular toxicity may be due to calcium channel blockade. In dogs, administration of intravenous calcium offset tilmicosin-induced tachycardia and negative inotropy (decreased contractility). Dobutamine partially offset the negative inotropic effects induced by tilmicosin injection in dogs. ß-adrenergic antagonists, such as propranolol, exacerbated the negative inotropy of tilmicosin injection in dogs. Epinephrine potentiated lethality of tilmicosin injection in pigs. This antibiotic persists in tissues for several days.

Precautions:
Do not allow horses or other equines access to water containing tilmicosin. The safety of tilmicosin has not been established in male swine intended for breeding purposes.

Always treat the fewest number of animals necessary to control a respiratory disease outbreak. Prescriptions shall not be refilled. Concurrent use of Pulmotil AC and another macrolide by any route is not advised. Use of another macrolide immediately following this use of Pulmotil AC is not advised.

Adverse Reactions in Animals: Decreased water consumption was observed in healthy pigs administered tilmicosin in target animal safety studies. Ensure that pigs have continuous access to medicated water during the treatment period. Monitor pigs for signs of water refusal and dehydration while being treated. If decreased water consumption occurs, replace the medicated drinking water with fresh non-medicated water and contact your veterinarian.

Clinical Pharmacology: Tilmicosin is a macrolide antibiotic with *in vitro* antibacterial activity primarily against Gram-positive bacteria, although certain Gram-negative bacteria are also susceptible. Macrolides interfere with bacterial protein synthesis by reversibly binding to the 50S subunit of the ribosome. They are typically regarded as being bacteriostatic, but at high concentrations can be bactericidal. When administered orally to pigs via the drinking water, tilmicosin is rapidly absorbed and slowly eliminated from the body. Tilmicosin distributes rapidly to the target tissues. Detectable levels are found in lung tissue as early as 6 hours and peak at about 5 days after the commencement of treatment. The relationship of serum tilmicosin concentration to lung tilmicosin concentration or the concentrations in bronchial secretion has not been determined. In addition, the extent to which total lung concentrations represent free (active) drug has not been defined. Therefore, no conclusions can be made with regard to the clinical relevance of elevated tilmicosin concentrations in the lung. Tilmicosin has been shown to concentrate within alveolar macrophages. It is also found at fairly high concentrations in liver and kidney tissue, as it is excreted both via the bile into the feces and also via the urine.

Effectiveness: The effectiveness of Pulmotil AC for the control of SRD associated with *P. multocida* and *H. parasuis* was confirmed in a natural infection field study across six U.S. sites. A total of 960 commercial-type grower pigs were enrolled and assigned to the tilmicosin-treated group (200 mg tilmicosin/L in drinking water for 5 consecutive days), or a non-medicated control group. Pigs that 1) were found dead and were diagnosed with SRD, or 2) had a depression score and a respiratory score ≥ 2 (on a scale from 0 [normal] to 3 [severe]) and a rectal temperature of ≥ 104.5 °F were considered clinically affected. At each site, treatments were initiated when at least 15% of the pigs were classified as clinically affected. After the 5-day treatment period and a 4-day post-treatment period, pigs were evaluated for treatment success (respiration and depression scores of 1 or 0 and rectal temperature < 104.5 °F), and were euthanized and evaluated for lung lesions. A significantly higher ($p = 0.0118$) success rate (based on back-transformed least squares means) was detected for the tilmicosin-treated group (275/473, 58.64%) compared to the control group (230/475, 47.89%).

The effectiveness of Pulmotil AC for the control of SRD associated with *M. hyopneumoniae* in the presence of PRRSV was confirmed in an induced infection model study. A total of 340 commercial-type pigs were enrolled and challenged with *M. hyopneumoniae* (single infection) or *M. hyopneumoniae* and PRRSV (co-infection). When necropsied sentinel pigs had at least 5% lung lesion involvement, study pigs were treated with Pulmotil AC (200 mg tilmicosin/L in drinking water) or non-medicated water for 5 consecutive days. After the 5-day treatment period and a 4 day post-treatment period, pigs were euthanized and evaluated for lung lesions.

For both the single infection and co-infection groups, the lung lesion percentage was statistically significantly different ($p = 0.005$ and $p = 0.0004$, respectively) in favor of the tilmicosin phosphate-treated group (21.01% and 31.74%, respectively) compared with the control group (28.26% and 43.04%, respectively).

Animal Safety: A pharmacokinetic study was conducted to evaluate Pulmotil AC concentrate solution in pigs. The results were compared to pharmacokinetic data generated with Pulmotil 90 Type A medicated article (NADA 141-064). The data demonstrates that blood and tissue levels of tilmicosin when administered to pigs at 200 mg/L (ppm) in water were consistently lower than when tilmicosin was administered to pigs at 181 g/ton (200 ppm) in feed.

A target animal safety study was conducted to evaluate the tolerance of Pulmotil AC concentrate solution in pigs when administered in drinking water. Twenty pigs were administered medicated water at 0, 200, 400, or 600 mg/L (0, IX, 2X, or 3X the labeled dose) for 5 consecutive days or 200 mg/L for 10 consecutive days. No treatment-related lesions were observed in any animals at necropsy. Water consumption was decreased in all tilmicosin-treated groups compared to the non-medicated group. One pig in the 600 mg/L group was euthanized due to decreased water consumption, neurological signs attributed to severe dehydration, and subsequent refusal to drink non-medicated water. Two pigs in the 400 mg/L group had reduced water intake and displayed mild clinical signs attributed to dehydration. One pig recovered after being offered non-medicated water. The second pig completed the treatment regimen without intervention.

Hydration and water consumption were evaluated during the control of SRD effectiveness field study. Tilmicosin was administered to study pigs in drinking water at 200 mg/l for 5 consecutive days. There was no statistically significant difference in water consumption between tilmicosin-treated pigs and pigs receiving non-medicated water. A subset of study pigs (20 tilmicosin-treated pigs and 20 non-medicated pigs) were evaluated for hydration via a physical examination and analysis of blood samples for hematocrit, total protein, creatinine, and blood urea nitrogen. There were no abnormal physical examination findings or clinically relevant differences in clinical pathology variables between tilmicosin-treated pigs and pigs receiving non-medicated water.

How Supplied: Pulmotil AC is provided in a 960 ml amber-colored plastic bottle sealed with a plastic screw cap.

Storage Conditions:
Store at or below 86° F (30° C). Protect from direct sunlight.

Restricted Drug (California) - Use Only as Directed
NADA # 141-361, Approved by FDA

Manufactured For:
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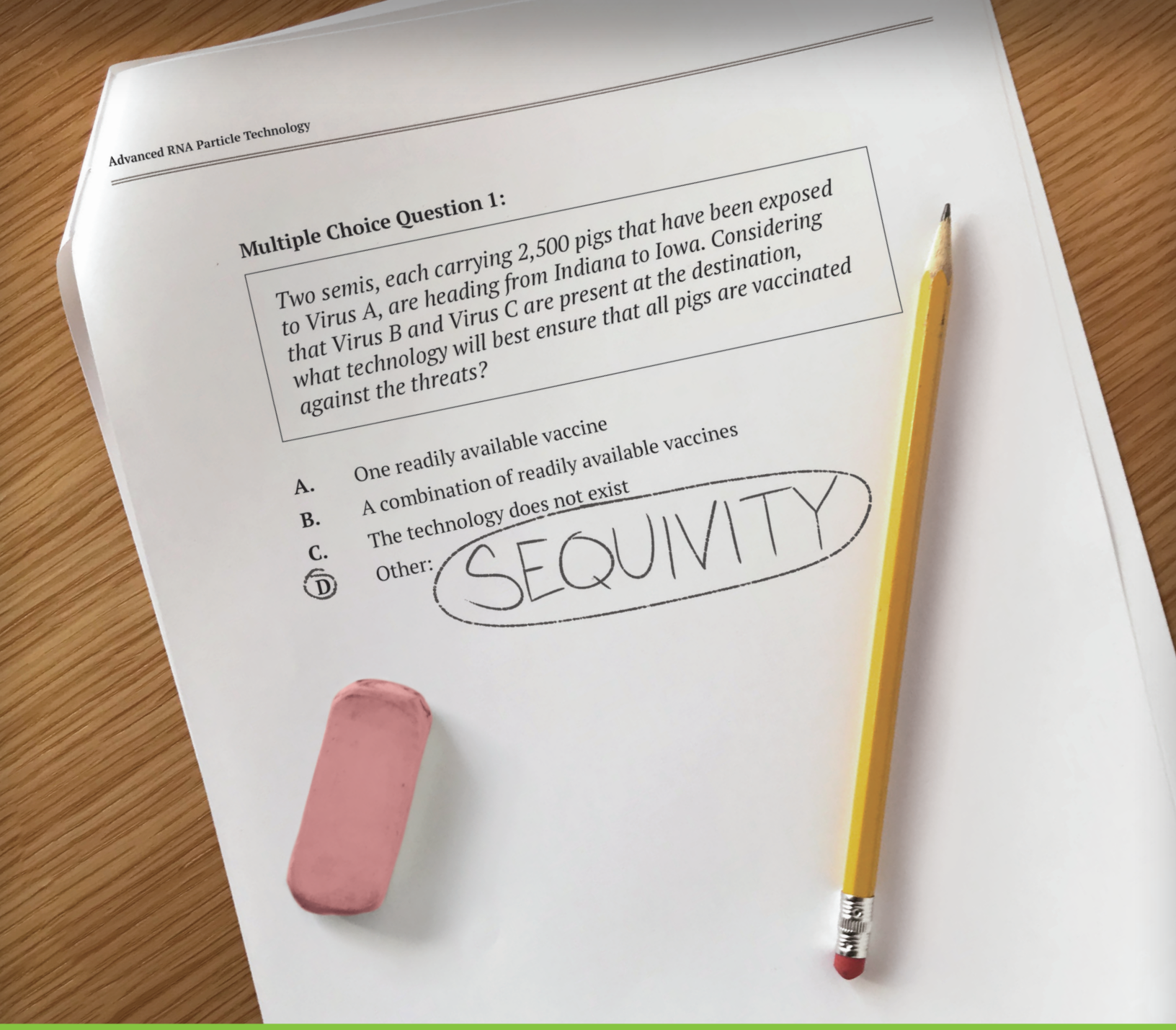
Greenfield, IN 46140, USA



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We are antibiotics aware

November 18-24, 2020 marks the annual World Antibiotic Awareness Week (see sidebar). Once again, the American Association of Swine Veterinarians is pleased to participate by sharing swine veterinarians' antibiotic awareness activities.

Slowing the development of resistance and preserving the effectiveness of antimicrobials for use in animals and humans are priorities for swine veterinarians. Antimicrobial resistance is a global, urgent One Health problem and threatens animal, human, and environmental health.

Antimicrobials also save lives. In addition to other disease prevention, control, and treatment strategies, judicious and responsible use of antimicrobials have a positive impact on animal health, animal welfare, and public health. They are a necessary therapeutic tool in swine populations to maintain a safe and secure pork supply. It is essential that we preserve their effectiveness by acting as stewards and using antimicrobials judiciously only when medically necessary, for a specific purpose, at the right dose, for the correct frequency and duration, and by the appropriate route of administration.

During 2019, AASV made a commitment to the Antimicrobial Resistance Challenge, a yearlong international effort to accelerate the fight against antimicrobial resistance. At that time, AASV pledged to continue providing swine veterinarians the resources, information, and knowledge they need to use antimicrobials judiciously and promote stewardship among producers, which includes veterinary oversight, use data collection, and disease prevention. Read more about AASV's 2019 commitment at **cdc.gov/drugresistance/intl-activities/amr-challenge.html**.

"The AASV Pharmaceutical Issues Committee continuously addresses issues with antimicrobial use and resistance and has been busy accomplishing goals set during the last year."

The AASV Pharmaceutical Issues Committee continuously addresses issues with antimicrobial use and resistance and has been busy accomplishing goals set during the last year. In 1999, the AASV, an early leader in developing guidelines for the judicious use of antimicrobials in veterinary medicine, published the first *Basic Guidelines of Judicious Therapeutic Use of Antimicrobials in Pork Production*. Following earlier revisions in 2004 and 2014, the Pharmaceutical Issues Committee again reevaluated and revised those guidelines during 2020.

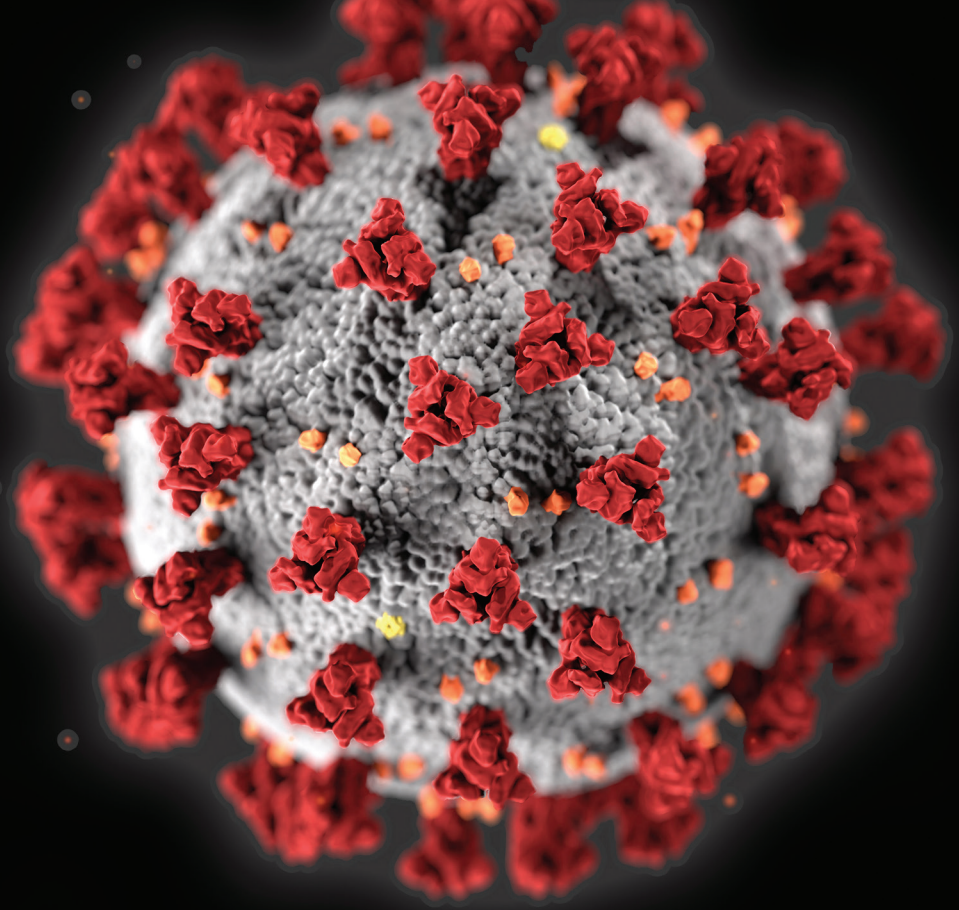
To represent the interests of swine veterinarians and advocate for the health of the pig, AASV is imbedded in conversations with other organizations where discussions and decisions about judicious use and stewardship are made. We work closely with other pork organizations to build relationships and discuss antimicrobial use with the Food and Drug Administration (FDA), the Centers for Disease Control and Prevention, and other agencies and stakeholders.

With input from the Pharmaceutical Issues Committee, the AASV responded to FDA during multiple public commenting periods during 2020. The AASV described the clinical importance of carbadox and encouraged FDA to use science-based decisions when considering revoking the approval method of carbadox. In response to a question FDA posed about transit and withdrawal times, the AASV provided answers to help FDA understand current industry practices and swine veterinarians' interpretation of labels. We requested that future labeling be explicit and based in science and evidence. The AASV supported FDA's list of bulk drug substances for compounding drugs for poison antidotes for food-producing animals and requested that bulk drug substances used to compound drugs for depopulation and euthanasia be included on that list. The AASV is currently reviewing the recently proposed National Antimicrobial Resistance Monitoring System 2021-2025 Strategic Plan and will submit comments that emphasize and prioritize pig health.

The AASV also works closely with allied veterinary organizations. Two AASV member representatives sit on the American Veterinary Medical Association's (AVMA) Committee on Antimicrobials. Those two AASV member representatives were instrumental in developing and reviewing the AVMA Committee on Antimicrobials' *Antimicrobial Resistant Pathogens Affecting Animal Health in the United States* report released in August 2020.

World Antibiotic Awareness Week is a global initiative to raise awareness of the health risks of antibiotic resistance to humans, animals, and the environment and to encourage best practices among healthcare providers, policy makers, and the public to limit the emergence or spread of resistant bacteria. The US effort is led by the Centers for Disease Control and Prevention with participation from governments, academic institutions, private industries, and non-governmental organizations. During the annual observance, organizations highlight their activities in promoting the importance of appropriate antibiotic use and antibiotic resistance.

Advocacy in Action continued on page 333



COVID-19

AASV Resources for Swine Veterinarians

aasv.org/resources/publichealth/covid19

Swine veterinarians have an essential role in providing services that protect public health and swine health and welfare.

The COVID-19 pandemic is impacting our practices, communities, clients, and families. The AASV continues to ensure you have the information you need to stay healthy and continue meeting a critical need. Find resources for:

- Veterinary practice, business, legislation, and CE
- Producers
- Crisis planning and animal welfare
- Industry

The AASV is committed to providing members with resources to promote and enhance well-being – the state of being comfortable, healthy, and happy.

Visit AASV's Veterinarian Well-being webpage at **aasv.org/resources/wellbeing**

to find resources to assess and improve your own well-being and resources to help support colleagues, clients, friends, and family.

Advocacy in Action continued from page 331

Led by Dr Peter Davies, then AASV Alternate Representative on the AVMA Committee on Antimicrobials, Drs Clayton Johnson, Locke Karriker, Jon Tangen, Connie Gebhart, and Joe Fent formed an expert swine health working group to provide a list of priority pathogens associated with disease in swine for which antimicrobial resistance is prevalent and poses a threat to the ability to effectively treat swine.

The comprehensive report details the impact of antimicrobial-resistant bacteria on different animal species in the United States. The report includes actions that veterinarians and other stakeholders can take to collaboratively combat antimicrobial resistance. The report consists of three sections:

- an overview of antimicrobial resistance impact on animal health in the United States,
- host species-specific summaries of pathogens of concern, and
- a technical appendix.

The report can be accessed at **avma.org/resources-tools/one-health/antimicrobial-use-and-antimicrobial-resistance/antimicrobial-resistant-pathogens-affecting-animal-health**.

The AASV continues to advocate for science-based approaches to veterinary and public health issues, including antimicrobial resistance, by promoting antimicrobial stewardship, creating and sharing resources for veterinarians, and prioritizing the health and welfare of the pig. Join us in participating in World Antibiotic Awareness Week by sharing stories and activities you do as a veterinarian to promote antimicrobial stewardship.

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

Cumulative index

The *Journal of Swine Health and Production* cumulative index is updated online throughout the year as issues go to press. Articles can be accessed via the "Search" function and from the Abstracts page, **www.aasv.org/shap/abstracts/**.

Index by title 2020

Cummulative index continued on page 337

Environment
Enrichment
Encouragement

A platform for nurturing & developing weaned pigs

STEP 3

Encouragement

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Cummulative index continued from page 335

Index by author 2020

Thank you, reviewers

for working together and creating a journal to be proud of!

The editorial staff of the *Journal of Swine Health and Production* would like to acknowledge the invaluable assistance of the following individuals for their service as referees for the manuscripts that were reviewed between September 23, 2019, and September 22, 2020.

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Gary Althouse
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Mike Tokach
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Jerry Torrison
Austin Viall
Heather Wilson
Paul Yeske
Beth Young
Jianqiang Zhang

We apologize if we have inadvertently left a reviewer's name off the list.

Upcoming meetings

ISU James D. McKean Swine Disease Conference

November 5 - 6, 2020 (Thu-Fri)
Scheman Building
Iowa State University
Ames, Iowa

For registration information:
Registration Services
Iowa State University
1601 Golden Aspen Drive #110
Ames, Iowa 50010
Tel: 515-294-6222
Email: registrations@iastate.edu

For questions about program content:
Dr Chris Rademacher
Conference Chair
Iowa State University
Email: cjrdvm@iastate.edu
Web: regcytes.extension.iastate.edu/swinedisease/

American Association of Swine Veterinarians 52nd Annual Meeting

February 27 - March 2, 2021 (Sat-Tue)

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

International Conference on Pig Survivability - POSTPONED UNTIL 2021

October 27 - 28, 2021 (Wed-Thu)
Hosted by: Iowa State University, Kansas State University, and Purdue University
Omaha, Nebraska

Conference contact:
Dr Joel DeRouchey
Email: jderouch@ksu.edu
Web: piglivability.org/conference

26th International Pig Veterinary Society Congress

June 2022
Rio de Janeiro, Brazil

For more information:
Tel: +55 31 3360 3663
Email: ipvs2020@ipvs2020.com
Web: ipvs2020.com

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

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Photo courtesy of Tina Smith