March and April 2015 • Volume 23, Number 2

Journal of Swine Health & Production

The Journal of the American Association of Swine Veterinarians

Journal of Swine Health and Production

(**ISSN 1537-209X**) Volume 23, Number 2; March and April 2015

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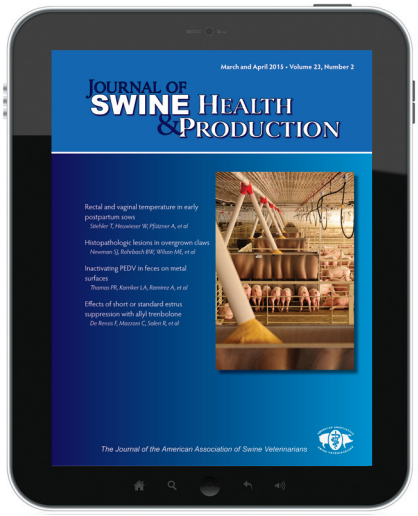

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"Veterinarians are the most experienced and educated individuals when it comes to the complexities involved in protecting and promoting animal welfare – and we took an oath to do so."

quoted from the President's message, page 65

PED VACCINE, RNA

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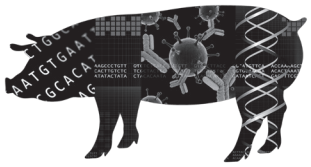

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Supply and demand

As many of you are aware, the rules associated with Proposition 2 took effect in California on January 1, 2015. Passed as a state ballot initiative approximately 6 years ago, it requires that veal calves, laying hens, and pregnant pigs be housed in a manner that allows them to lie down, stand up, fully extend their limbs (including wings), and turn around freely. Furthermore, in 2010, California lawmakers passed a bill requiring that all shell eggs sold in California originate from farms that meet Proposition 2 requirements.

This is one example of consumer demand driving available supply. Consumers voted and now the supply side of the equation must comply. My concern about this approach, specifically sweeping state legislation with federal implications, is that consumer choice is limited to that of the majority – not necessarily the public majority, but the majority who voted that day. I am fully supportive of consumer choice and people having the opportunity to purchase what they want (and can afford). My concern is that those who voted against Proposition 2, who want – and in many cases need – less expensive eggs, no longer have that option.

Supply driven by consumer demand also occurs when people vote with their dollars. The supply side of the equation provides options, and consumers dictate how much of the commodity is needed to meet demands for different products (eg, conventionally housed, cage-free, antibiotic free). Prices are determined by relative supply and demand.

As I look at the supply-and-demand equation for our association and its members, I can think of several examples where the swine industry and our profession have shifted to meet a changing or growing demand, as well as several future opportunities. For example, when consumers demanded a leaner protein product, the swine industry responded. Veterinary involvement was necessary throughout the process and in the health and welfare challenges that ensued when faster growing, leaner animals started to become more prevalent. Similarly, veterinary involvement was paramount when the swine industry largely moved indoors to meet growing demands for protein. Much thought went into barn designs, pen arrangements, feed and water delivery systems, heating and cooling systems, etc. Veterinary involvement will be important as we again alter gestation housing at the request of our customers.

"The AASV is well-positioned to facilitate our members in meeting these growing demands on our clients, our profession, and the industry we serve."

In addition to sow housing configurations and group feeding systems, piglet euthanasia methods and pain mitigation strategies for piglet processing procedures are being investigated. Veterinary guidance is necessary throughout the research process and especially through the implementation phase of new methods or technologies that arise from these studies.

Food and Drug Administration Guidance 209, Guidance 213, and proposed Veterinary Feed Directive regulations have also changed the demands on the swine industry. Increased instruction regarding appropriate antibiotic use continues to require veterinary involvement as product labels change and fewer over-the-counter products are available. There will also be an increased demand for veterinary-client interaction as the new Swine Industry Audit Platform is incorporated. Veterinarians will be called upon to help farmers achieve and maintain the health and welfare parameters outlined in the standards. There will also be an increased need for auditors, a role veterinarians are well qualified to fulfill, as customers demand more farms are audited.

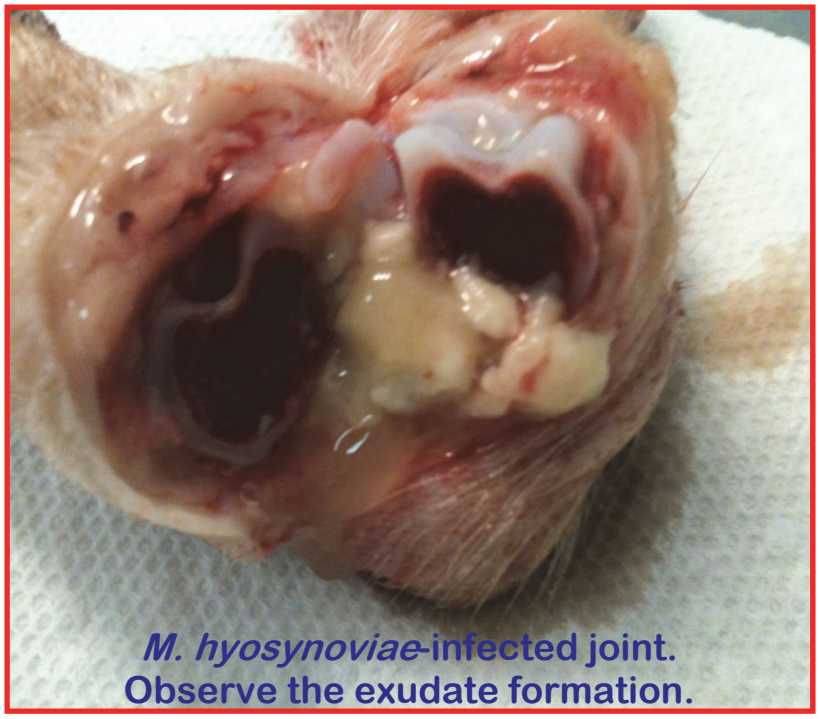
I anticipate an increasing demand for animal welfare experts in the future. Veterinarians are the most experienced and educated individuals when it comes to the complexities involved in protecting and promoting animal welfare – and we took an oath to do so. We need to be sure our supply of trained, experienced, credentialed animal-welfare experts is able to meet the growing demand while still meeting demands to safeguard animal and public health.

We will need to continue to embrace the changing demands on the swine industry and address them more nimbly. There will likely be more legislative and regulatory influence on our professional activities, drafted primarily by people not involved in food-animal production. Veterinarians and farmers will need to work together to optimize the health and welfare of the animals under our care in spite of these often well-intentioned rules. The AASV is well-positioned to facilitate our members in meeting these growing demands on our clients, our profession, and the industry we serve.

This being my last President's message, I would like to thank the AASV staff, AASV officers and BOD, the *JSHAP* staff, my family, my partners and coworkers, and my colleagues for your support, mentorship, and sacrifice. I am fortunate to be part of an association full of members willing to offer their time and talents to further the mission of the AASV. Thank you for the opportunity to serve our organization in this capacity.

Michelle Sprague, DVM
AASV President

Is Lameness from Mycoplasma Infection Hobbling Your Profits?



M. hyosynoviae-infected joint.
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An association of "doers"

Last year it was porcine epidemic diarrhea (PED) virus. A few years ago it was swine influenza virus. Not many years before that it was circovirus. A couple of decades before that, it was a mystery disease which became known as porcine reproductive and respiratory syndrome (PRRS). Another decade earlier, pseudorabies (Aujeszky's disease) was the enemy. While I was in veterinary school, transmissible gastroenteritis (TGE) was a big problem, along with SMEDII or parvovirus, and before that it was the great-grandfather of them all – hog cholera or classical swine fever.

When I was in veterinary school, it was the ending days of the hog cholera eradication program, and the United States was declared free of hog cholera virus while we were studying it. Had I known then what role viruses would play in the next 35 years of swine veterinary practice, I would have paid closer attention during Hank Harris's virology class, rather than thinking about how I could get to rugby practice on time.

Fresh out of veterinary school, a whole generation of us cut our teeth on that new disease – pseudorabies. We never knew where it came from, possibly Europe – a herpes virus was the villain. It started in the late 1970s, creating a panic similar to last year's with PED. It started in the eastern corn belt, and didn't find its way to Nebraska for a year or two until 1980 when it really "snowballed" – no pun intended – it moved in the wintertime like TGE, and we would learn that PRRS and PED also snowballed in the winter months. Farms were trying to avoid the spread, and the term biosecurity was coined. Alex Hogg, our Nebraska Extension Swine Veterinarian, was our biosecurity advisor of the time. Pseudorabies dominated discussions for many years as members tried to learn how to reduce its spread and eliminate it from herds.

"Mystery disease" in the late '80s found its way into the United States from an unknown origin. It was a cluster of clinical signs under the acronym PRRS, caused by an unidentified virus. University diagnosticians were called out to farms to investigate cases. It took nearly a decade to identify the virus and develop vaccines to help manage and control this costly RNA virus which we still battle.

"Today, our challenge in addition to disease is to change the public's paradigm about agriculture in general, their food in particular, and public perception of food-animal veterinary medicine."

In the "new" century, huge numbers of pigs in growers were dying. Veterinarians and their clients were again in a state of panic and the markets were moving in response to the next big swine epidemic – porcine circovirus type 2. This time university diagnostic laboratories quickly identified the causative virus and it took only a couple of years to develop the vaccines to help control it.

Now, we're in the PED panic. The cycle of discovering and identifying the cause was merely weeks. The efficiency of that process shared by several universities is truly an amazing accomplishment. Greg Stevenson, a key investigator at Iowa State University involved with identification of this new corona virus, must have been listening while we sat together in Hank Harris's virology class.

The AASV has gained its identity from the challenges of each new viral disease. It is interesting to look back and observe how frequently history repeats itself. We have a long and successful chronicle of identifying and controlling disease after disease and minimizing the effects for our clients. But I've got news for you.... For today's veterinarian, the challenges are not quite as clear. Or should I say, our challenges are not ONLY diseases.

Today, our challenge in addition to disease is to change the public's paradigm about agriculture in general, their food in particular, and public perception of food-animal veterinary medicine. To meet this challenge, our AASV Board of Directors has modified our mission statement as described in Michelle Sprague's January *JSHAP* "President's message."[1] The changes are right on target!

For some time now, the AASV has stepped beyond serving and educating our members. Our Executive Director, Dr Tom Burkgren, is often called upon by the media to provide a "voice of reason" with regard to animal agricultural and food safety issues. Advocating for the health and wellbeing of pigs and for the health of the public are very important tenets for us to uphold as stewards of our food supply. The AASV may be entering an era of advocacy. As a private practitioner directly involved with people who care for pigs, expanding the role of AASV is "a little scary." We are stepping beyond our "disease core competency." This may lead to a little broader involvement with the public, but it is needed to enhance our professional image. I like Dr Sprague's observation – "we are very fortunate to have an association of 'doers'". An association of "doers." I can't wait to see what we "do" next!

Reference

1. Sprague M. We're on a mission! [President's message]. *J Swine Health Prod*. 2015;23:5.

Ron Brodersen, DVM
AASV President-elect

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A variety of in-depth tools allow advanced utilization of diagnostics and data analysis. The most important tool we use, however, is listening.

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Maximize your reading – Part 2

In my last editorial I started a conversation about maximizing your scientific reading.[1] I hope we can agree that one challenge the busy veterinary practitioner faces today is staying current in the literature. Finding the time to read and keep our scientific knowledge current isn't always easy. In my previous editorial, I suggested techniques for how I "pre-screen" or prioritize an article to read and I would like to continue with that theme.[1]

Once I have decided to dive into the body of an article, I then go through a mental check list of what type of information the paper will provide. I quickly check the manuscript genre and read the introduction and aim(s) of the study – for the purposes of this editorial, a study could refer to any of the genres typically published by the *Journal of Swine Health and Production (JSHAP)*. Understanding the genre of the manuscript is important to help you critically review and utilize the information. If you need a refresher on manuscript genres and how they each contribute to the literature, I encourage you to re-visit my previous editorial titled "Manuscript genres."[2] Once I know the genre, I move to the introduction section and look for the date when the work was conducted. In general, there is a delay in publication during the peer-review process, and there also can be a delay in submitting papers to journals from the time the work was completed. Understanding when the research was conducted and when the article was submitted, as well as the time of final acceptance by the journal, is a good way to affix a timeline to the information and subsequently understand how current the information may be. I discussed publication timelines in more detail in my editorial titled "The peer-review process."[3]

> *"…the introduction should provide an indication of what gap of knowledge the current research will aim to fill."*

In simple terms, the introduction should tell you why the authors did the research. The primary research question or problem should be clearly stated and an outline of theoretical issues and supporting knowledge should be presented to support the research question, eg, while it may be clear to some people, the authors should state why the topic is so important to research in the first place. Additionally, the introduction should provide an indication of what gap of knowledge the current research will aim to fill. If I have difficulty finding this information I may just stop reading here. If the objectives or aims are not clearly stated, then it is difficult for a reader to critique the information that follows and hence difficult to know how it may apply to you in practice or other work.

The materials and methods section is next. In general this section should provide enough information to allow the research to be replicated. There should be a clear description of the methods used from subject (eg, pig) selection, tests applied (eg, diagnostic tests), to statistical methods used to evaluate the data. The subjects (pigs) should be described in detail, as well as housing and environmental conditions. An indication of how the subjects were selected should be provided. Probability sampling or random selection of subjects is often cited as preferred because random sampling helps to minimize selection bias.[4] This is important because the aim of true random selection is to give each pig or farm an equal opportunity to be selected for a study. Yet, in reality, true random sampling can be very challenging in veterinary medicine. Not every farm will want to or be able to participate, not every pig will be available to participate (ie, difficult to catch or find), and not every person will want to participate. On pig farms it can be far more time consuming to individually identify a herd of nursery pigs in order to provide a list from which pigs can be randomly selected. Another reason why random sampling is important is that most statistical procedures apply to random samples.[4] Most statisticians would argue that this is most important, as otherwise our statistical tests are difficult to impossible to interpret.

In *JSHAP* as well as many other journals, an ethical statement is usually provided as part of the materials and methods section. There should be some mention of animal use approvals or human ethics approvals obtained that will ensure that the confidentiality of participants is maintained and describe how data will be stored securely. This statement also helps to assure that animals were used and treated in a humane manner.

Keep an eye out for the next issue for the continuing conversation on maximizing your reading.

References

1. O'Sullivan T. Maximize your reading – topics, titles, and abstracts [editorial]. *J Swine Health Prod*. 2015;23:9.

2. O'Sullivan T. Manuscript genres [editorial]. *J Swine Health Prod*. 2013;21:183.

3. O'Sullivan T. The peer-review process [editorial]. *J Swine Health Prod*. 2013;21:299.

4. Dohoo I, Martin W, Stryhn H. Sampling. In: *Veterinary Epidemiologic Research*. 2nd ed. Charlottetown, Prince Edward Island, Canada: VER Inc. 2009:33–55.

Terri O'Sullivan, DVM, PhD
Executive Editor

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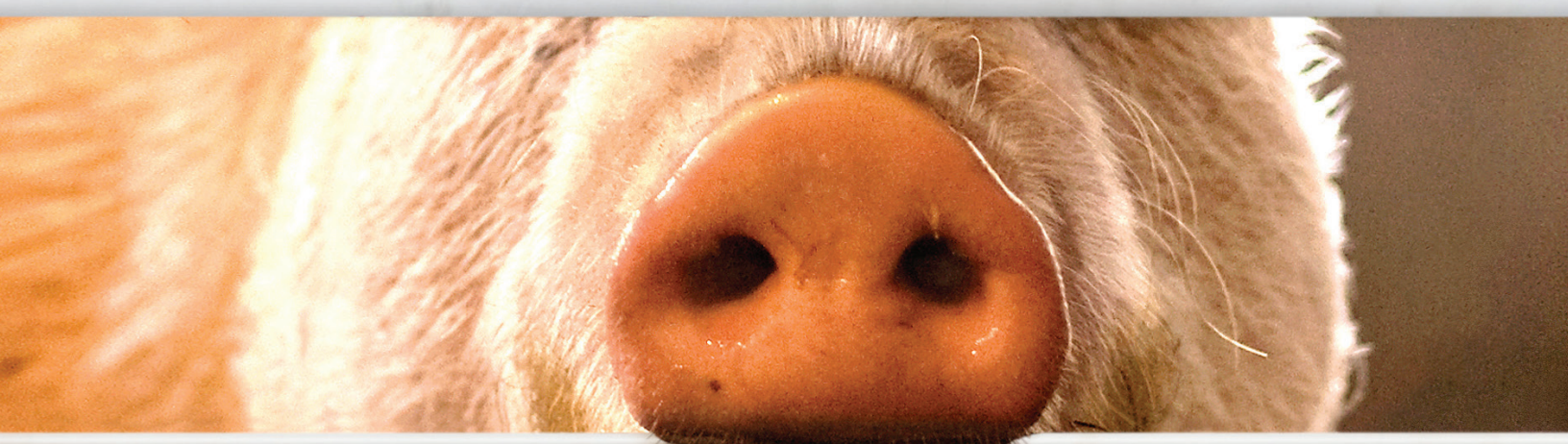

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Why I do what I do

For me the answer is fairly short and simple: my faith, my work ethic, the people around me, a passion for agriculture and farming, a passion for cattle, and a passion for the pig.

I still remember the night in 1981 when I was 12 years old watching the movie *A Bitter Harvest* with my parents, who were crop and dairy farmers. I imagine many of you remember this movie. It portrayed a dairy farmer going through devastation after his cows were mysteriously "poisoned." Cows were sick, and his family was sick from drinking the milk. The entire herd was eventually euthanized near the end of the movie. As a young girl, I remember being in tears and thinking, "By God, I am going to keep things like that from ever happening to livestock." Looking back, I can laugh at what a naive, childish, and impossible thought that was. Parallel situations still exist for us today, and they always will. Over the last year, we all have seen the devastation in herds created by porcine epidemic diarrhea virus alone, without even mentioning other pathogens. Nonetheless, it is that same passion I felt then, at 12 years old, that I feel today. I know I echo the thoughts of many of you reading this. We are driven by the deep desire to make things better for the livestock we care for. The one thing that never changes is the livestock – they are always there and they never seem to disappoint me. And many times when running farm calls, my basic care for the livestock might be the sole motivation that can get me there.

As swine veterinarians, we are the James Herriots of modern-day swine medicine. My copy of *All Things Wise and Wonderful* has a picture of James Herriot holding a pig, while looking into the face of a sow, with an expression of happiness. I feel this contentment and truly love working with pigs. If I want to smile or laugh on any day, I go into a grow-finish facility, wait a moment, and there will be some activity to make me laugh. When I'm in a sow unit, I truly love the sows – they are mothers, and I have an honest appreciation for what they do.

> *"We are driven by the deep desire to make things better for the livestock we care for."*

My work ethic is a big part of why I do what I do, and I fully believe that working in agriculture develops a work ethic like no other. I was led by my parents' example: they are now in their 70's and still farm to the grind. As a family growing up, most of our time spent together was *working together.* I want to lead my son, Wyatt, by example so that he understands the significance of hard work and carries this through his life. My son and I have our own beef cattle and I maintain a small beef-cattle practice – it simply is a labor of love. To this day, when I bed my cattle, I always wait and watch. When they play in the straw, I find such humor and enjoyment in it, and so does my son. I love being in the presence of cattle, and do not like it when they are not in my life.

I am blessed to work in agriculture and experience wonderful things in life, including all the people around me. The people around you are family, and getting to work first hand with people committed to production agriculture is a joy. Colleagues, producers, farm managers and employees, clients, and farmers are some of the most wonderful people to work with in the agricultural industry. I work hard to learn as much as I can from many of these talented individuals. In one way or another, their lives have an impact on mine.

In the greater picture of things, my faith is the cornerstone of why I really do anything. To be able to care about the livestock and the people around me is a wonderful blessing. I believe it is what I am supposed to do in life.

Now, after the not-so-short-and-simple version, the answer ultimately remains the same. I do what I do because of a passion for the pig, cattle, agriculture and farming, the people around me, my work ethic, and my faith.

Lynette Holman, DVM
Staff Veterinarian,
Swine, Kalmbach Feeds

The course of rectal and vaginal temperature in early postpartum sows

Tina Stiehler; Wolfgang Heuwieser, Prof Dr med vet; André Pfützner, DVM; Onno Burfeind, Dr med vet, Diplomate ECAR

Summary

Objectives: To investigate the course of body temperature in early postpartum sows and possible factors that may influence it, and to examine the influence of a vaginal temperature logger on body temperature by including a control group of sows without loggers.

Materials and methods: The study was conducted on a commercial pig farm from January to May 2013. A total of 156 sows received a vaginal temperature logger for 6 days post partum and 43 sows remained without loggers (negative control group). Vaginal temperature was measured at 10-minute intervals. Rectal temperature, feed intake, general condition, and vaginal discharge were evaluated daily.

Results: The sows showed a clear circadian rhythm of vaginal temperature, with minimal mean temperature 39.0°C (standard deviation [SD] 0.5°C) from 5:00 AM to 6:00 AM and maximum mean temperature 39.4°C (SD 0.5°C) from 1:00 PM to 7:00 PM ($P < .05$). Day post partum ($P < .01$), time of day ($P < .01$), age ($P < .01$), general condition ($P < .01$), vaginal discharge ($P < .01$), and treatment for postpartum dysgalactia syndrome ($P < .01$) had effects on rectal and vaginal temperature.

Implications: Measurement of body temperature should be made at the same time every day. Use of vaginal temperature loggers is a practicable method for on-farm studies to gain more information about the course of body temperature in postpartum sows. Body temperature should not be used as the single criterion for the decision to administer medical treatment.

Keywords: swine, postpartum dysgalactia syndrome, rectal temperature, temperature logger, vaginal temperature

Received: January 16, 2014
Accepted: August 7, 2014

Resumen - Seguimiento de la temperatura vaginal y rectal en hembras en los inicios del postparto

Objetivos: Investigar el seguimiento de la temperatura corporal en hembras al inicio del post-parto y los posibles factores que puedan influenciarla, y examinar la influencia de un aparto de registro (logger) de la temperatura vaginal en la temperatura corporal al incluir un grupo control de hembras sin loggers.

Materiales y métodos: El estudio se realizó en una granja comercial de cerdos de enero a mayo 2013. Un total de 156 hembras recibieron loggers vaginales durante 6 días post parto y 43 hembras permanecieron sin loggers (grupo control negativo). La temperatura vaginal se midió en intervalos de 10 minutos. Diariamente se evaluaron la temperatura rectal, consumo de alimento, condición general, y secreción vaginal.

Resultados: Las hembras mostraron un ritmo circadiano claro de la temperatura vaginal, con un promedio mínimo de temperatura de 39.0°C (desviación estándar [SD] 0.5°C) de 5:00 AM a 6:00 AM y una temperatura máxima promedio de 39.4°C (SD 0.5°C) de 1:00 PM a 7:00 PM ($P < .05$). Día de postparto ($P < .01$), hora del día ($P < .01$), edad ($P < .01$), condición general ($P < .01$), secreción vaginal ($P < .01$), y tratamiento para el síndrome de agalactia post parto ($P < .01$), tuvieron efectos en la temperatura rectal y vaginal.

Implicaciones: La temperatura corporal debería medirse a la misma hora cada día. La utilización de loggers de temperatura vaginal es un método viable para estudios en granja para obtener más información sobre el curso de la temperatura corporal en hembras en postparto. La temperatura corporal no debería utilizarse como el criterio único en la toma de decisión para administrar tratamiento médico.

Résumé - Évolution des températures rectale et vaginale chez des truies en début de période post partum

Objectifs: Examiner l'évolution de la température corporelle chez des truies en début de période post partum et les facteurs potentiels qui pourraient l'influencer, ainsi qu'évaluer l'influence d'un capteur de température vaginale sur la température corporelle en incluant un groupe témoin de truies sans capteur.

Matériels et méthodes: L'étude a été réalisée sur une ferme commerciale de janvier à mai 2013. Au total, 156 truies ont eu un capteur de température vaginale pendant 6 jours en période post-partum et 43 truies n'ont pas eu de capteur (groupe témoin négatif). La température vaginale a été mesurée à des intervalles de 10 minutes. La température rectale, la quantité d'aliment consommé, la condition générale, ainsi que l'écoulement vaginal ont été évalués quotidiennement.

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

Stiehler T, Heuwieser W, Pfützner A, et al. The course of rectal and vaginal temperature in early postpartum sows. *J Swine Health Prod.* 2015;23(2):72–83.

Résultats: Les truies ont clairement montré un rythme circadien en ce qui regarde la température vaginale, avec une température minimale moyenne de 39,0°C (écart-type [ET] 0,5°C) entre 05:00 et 06:00 H et une température maximale moyenne de 39,4°C (ET 0,5°C) entre 13:00 et 19:00 H ($P < 0,05$). Le jour post partum ($P < 0,01$), le moment de la journée ($P < 0,01$), l'âge ($P < 0,01$), la condition générale ($P < 0,01$), l'écoulement vaginal ($P < 0,01$), et le traitement pour le syndrome de dysgalactie postpartum ($P < 0,01$) avaient des effets sur les températures rectale et vaginale.

Implications: La prise de température corporelle devrait être faite au même moment à chaque jour. L'utilisation de capteur de température vaginale est une méthode pratique pour les études à la ferme afin d'obtenir plus d'informations sur l'évolution de la température corporelle chez les truies en période post-partum. La température corporelle ne devrait pas être le seul paramètre à utiliser pour décider de l'administration d'un traitement médical.

Postpartum diseases of sows remain an important problem in the pig industry, affecting animal health and welfare of sows and piglets. Many terms are used to describe these disorders, such as mastitis, metritis, and agalactia,[1] swine urogenital disease,[2] periparturient hypogalactic syndrome,[3] or postpartum dysgalactia syndrome (PPDS).[4,5] The diverse terms reflect the variability of the etiology and clinical signs, which are mastitis, metritis, constipation, cystitis, anorexia, and pyrexia.[6] Today, the term "postpartum dysgalactia syndrome" has been accepted in English-speaking areas to describe this postpartum disorder of sows.[4,5,7] A common method to identify sick animals is measurement of rectal temperature in the first 3 days post partum, but temporary hyperthermia is often observed in postpartum sows.[8]

In recent studies, various methods of continuously measuring body temperature in pigs were evaluated. Hanneman et al[9] measured body temperature by a sensor inserted at the base of the ear. In this study, a circadian temperature rhythm was demonstrated and quantified in growing-finishing pigs, but the procedure was invasive. The use of infrared thermography is fast and practical, but not suitable for observation of the health status of individual animals.[10,11] Vaginal temperature loggers were recently validated for measuring vaginal temperature in cows[12,13] and sows[14] after parturition and in gilts after vaccination.[15] Only minor differences were observed between rectal and vaginal temperature in cows.[12,13] In sows, correlation between rectal and vaginal temperature was high (r = .80; $P < .01$), but vaginal temperature was 0.3°C higher than rectal temperature, which has to be considered when interpreting measures of vaginal temperature generated with this technology. In gilts, a linear correlation existed both in vaccinated gilts (r = .86, n = 21; $P < .001$) and non-vaccinated gilts (r = .65, n = 22; $P < .001$), and most of the differences between rectal and vaginal temperature were within two standard deviations.[15]

To date, there is a dearth of information about factors that might influence body temperature in early postpartum sows under field conditions. Therefore, the overall objectives of this study were to continuously measure body temperature of postpartum sows in a commercial setting, investigate plausible factors that may influence body temperature, and, in addition, examine whether body temperature in sows showing no overt clinical signs can be considered pyrexia, as has been described for healthy postpartum dairy cows.[16]

Materials and methods

This study was approved by the Institutional Animal Care and Use Committee of the Clinic of Animal Reproduction, Freie Universität Berlin. Sows were managed according to the guidelines set by the International Cooperation and Harmonisation of Technical Requirements for Registration of Veterinary Medical Products.[17]

Herd and facilities

The study was carried out on a commercial pig farm with 1370 sows in Brandenburg, Germany. The herd was positive for *Actinobacillus pleuropneumoniae, Haemophilus parasuis, Mycoplasma hyopneumoniae,* porcine circovirus type 2, and porcine reproductive and respiratory syndrome virus (PRRSV). The sows were regularly vaccinated against *H parasuis, Clostridium perfringens* Type A, *Escherichia coli,* and PRRSV. The sows were moved to farrowing crates approximately 7 days prior to expected farrowing, with five farrowing rooms in three barns. The front third of the farrowing crates had solid concrete floors, with a covered and heated region for the piglets and a fully slatted floor in the back region. When moved into the farrowing room, sows were fed a lactation ration (energy, 13.0 MJ per kg; crude protein, 17.5%; crude fiber, 6%; crude ash, 6%; crude oil and fats, 5%) at 6:00 AM and at 1:00 PM, with continuous access to water from a nipple drinker. The amount fed was increased after farrowing. Routine management of piglets included ear notching for identification, iron injection (1 mL Belfer iron (III)-hydroxid-dextran-complex, 100 mg per mL; bela-pharm GmbH & Co KG, Vechta, Germany), and castration of the male piglets during the first 6 days. Sows and piglets remained in the crates until the piglets were weaned at 28 days of age.

Study design

Every Thursday, 12 ± 2 sows, including 2 ± 1 gilts (mean ± standard deviation) were enrolled in the study for the duration of 16 weeks. On this farm, most sows farrowed Wednesday and Thursday, with farrowing not complete in many sows until Thursday afternoon. Only sows that had finished farrowing and completely expelled the placenta were included in the study. Included sows farrowed either on Wednesday or Thursday morning. On the first day after farrowing, in 10 ± 2 of these sows, a microprocessor-controlled temperature logger was inserted into the vagina, as recently validated for sows.[14] A group of sows enrolled as negative controls (2 ± 1 sows) did not receive a logger. The temperature logger (Minilog 8; Vemco, Ltd, Halifax, Nova Scotia, Canada; size = 92 × 20 mm, weight = 40.5 grams) was attached to a modified vaginal controlled internal drug release device (CIDR-blank; InterAg, Hamilton, New Zealand). A part of the plastic frame of the CIDR was removed and the flexible part was pulled over the logger. A thin cord was attached to the plastic frame of the CIDR so that it could easily be pulled out after use. Before use, the combination of CIDR and logger was submerged in a povidone iodine solution for a minimum of 5 minutes (Braunol; B. Braun, Melsungen AG, Melsungen, Germany) and immediately on removal, without rinsing, inserted into the vagina of the standing or lying sow with the help of a tubular speculum (tubular speculum for pigs (length 40 cm, inner diameter 2.5 cm; WDT, Garbsen, Germany). The logger was pushed through the speculum with a CIDR applicator

and positioned caudal to the cervix. This procedure required no restraint or sedation of the study animals. The logger remained in the vaginal cavity for a total of 6 days, measuring vaginal temperature at 10-minute intervals. The number of piglets born alive, stillborn piglets, and the birth weight of the litters were noted at enrolment, with each litter weighed as a group. Piglet mortality, medical treatment of sows, number of piglets weaned, and litter weight at weaning were documented.

Daily observation of the animals, measurement of rectal temperatures, and medical treatment were conducted by the herd manager (investigator), who had completed 3 years of education comparable to a veterinary technician course. Before starting the study, the investigator underwent a 3-day training period with the first author, including 20 sows each day, assessing general health status, feed intake, and vaginal discharge, measuring rectal temperature, and implementing medical treatment. In the first 2 weeks of the study, the first author and investigator examined all study animals together to ensure that the measurements and examinations were performed consistently. In addition, every Thursday, when new study animals were enrolled, observations were performed simultaneously by the first author and the investigator. A data capture form was attached above the farrowing crate of each sow. From day 1 to day 6 of the study, the animals were clinically examined by the investigator. First, feed intake was evaluated by visual examination on a three-point scale (complete intake of feed, partial intake, or no feed intake). Second, the investigator scored general condition of the sow on a three-point scale: healthy, sow was attentive, standing up for feeding, nursing the piglets; slightly reduced, sow seemed apathetic, did not nurse the piglets, ie, remained in ventral recumbency, not allowing the piglets to nurse, but stood up for feeding; severely reduced, sow was somnolent, remained recumbent, did not nurse the piglets, and did not stand up for feeding. Rectal temperature was measured twice daily (morning and afternoon) and vaginal discharge was evaluated by the investigator. Vaginal discharge was characterised as purulent or mucopurulent to simplify scoring. On day 7 of the study, the loggers were removed, which required no restraint or sedation. Litters were reweighed at weaning (day 28).

For analysis, a sow was categorized as ill when three clinical criteria were abnormal: reduced general condition, reduced feed intake, and vaginal discharge with a rectal temperature > 40.0°C.[18] Not all sows categorized as ill were given medical treatment, as illness was classified retrospectively after the study ended. The herd manager provided all medical treatment of ill animals to ensure that treatment decisions were comparable. The standard operating procedure for treatment of PPDS included an intramuscular (IM) injection of 5 mg per kg body weight (BW) enrofloxacin (Floxibac, 100 mg per mL; Chanelle Pharmaceuticals Manufacturing Ltd, Loughrea, Co Galway, Ireland) once daily for 3 consecutive days; an IM injection of 50 mg per kg BW metamizol (Metapyrin, 500 mg per mL; Serumwerk Bernburg AG, Bernburg, Germany) once daily for 3 consecutive days; and a single IM injection of 10 mg dinoprost (Dinolytic, 5 mg per mL; Zoetis Deutschland GmbH, Berlin, Germany) on the first day of treatment. Sows with purulent vaginal discharge for more than 1 day, but without other overt clinical signs, received only a single injection of 10 mg dinoprost. For further analysis, the single injection of dinoprost was classified as medical treatment.

After the piglets were weaned, the study sows were routinely moved to the breeding centre for insemination in the following estrus. Pregnancy diagnosis was performed via ultrasound by the herd veterinarian 4 weeks after insemination. The results of this examination were used to analyse the pregnancy rate of animals with and without loggers for a preliminary indication of whether or not use of the vaginal loggers might have a detrimental effect on subsequent reproductive performance of the sows.

Statistical analysis

Data were recorded in Excel (Office 2010; Microsoft Deutschland GmbH, Munich, Germany) and analysed using SPSS for Windows (Version 20.0; SPSS Inc, Munich, Germany). Vaginal temperatures below 38.0°C were considered artefacts and excluded from analysis.

To study plausible factors that might be associated with body temperature (rectal and vaginal temperatures), their effects were tested in a univariate analysis of variance: day postpartum, hour of the day (actual time, vaginal temperature only) or time of day (morning or afternoon, rectal temperature only), age, logger (sows with or without loggers), piglets born alive, litter weight at day 1, litter weight at day 28, mean weight gain of the litter, vaginal discharge, feed intake, general condition, illness, medical treatment, PPDS treatment, and week of study. Fixed effects tested included the day postpartum (1 to 6), hour of the day (1 to 24), or time of day (1 = morning, 2 = afternoon), age (1 = gilt; 2 = parity 2 to 4; 3 = parity 5 or greater), logger (0 = no vaginal logger; 1 = vaginal logger), piglets born alive (eight to 19), vaginal discharge (0 = no vaginal discharge; 1 = vaginal discharge), illness (0 = fewer than three clinical signs, 1 = three clinical signs), medical treatment (0 = no; 1 = yes), PPDS treatment (0 = no; 1 = yes), and week of study (1 to 16). The three-point scales of feed intake and general condition were converted into a two-point scale to minimize the problem of subjectivity. Therefore feed intake (1 = complete intake; 2 = partly or no intake) and general condition (1 = healthy; 2 = slightly or severely reduced) were tested as fixed effects. Litter weight at day 1 and at day 28 and mean litter weight gain were tested as covariates. All variables with a univariable $P < .20$ were included in a repeated measures linear mixed model with repeating day post partum (one for rectal temperature and one for vaginal temperature, respectively). Models were constructed in a backward stepwise manner using the scale-identity structure. Pearson's and Spearman's correlation (ρ) between the parameters were determined. If two variables were highly correlated ($r > .5$), only the variable with the smaller P value was included in the final model.

Results

A total of 199 sows were included in the study. In 156 sows, a vaginal temperature logger was inserted after parturition. The remaining 43 sows (negative controls) did not receive a temperature logger. A total of 15 sows were excluded from vaginal temperature analysis because of logger losses (n = 10, 6.4%) or technical problems with the loggers (n = 5, 3.2%). These 15 sows, however, were included in the rectal temperature analysis. A total of 34 gilts and 165 pluriparous sows were used in the study, with 100 sows in parities 2 to 4 and 65 sows in parities 5 to 10 (mean parity 3.8, SD 2.3, including gilts).

Temperature loggers recorded 118,127 ten-minute readings of vaginal temperature from 141 sows. Of these readings, 468 (0.4%) were below 38.0°C and excluded from analysis. For further statistical analyses of vaginal temperature, only 18,509 readings from day 1 to 6 were used because rectal temperature was measured and examinations performed during this period, whereas vaginal temperature alone was measured until the morning of day 7.

Vaginal temperature showed a clear circadian rhythm, with the lowest temperature in the morning from 5:00 AM to 6:00 AM and the highest temperature in the afternoon from 1:00 PM to 7:00 PM (Figure 1). Vaginal temperature began to increase parallel with activities in the farrowing pen (eg, feeding at 6:00 AM, cleaning of farrowing pens, and medical treatments in the morning). Temperature rose until 3:00 PM and stayed high until 7:00 PM (Figure 1).

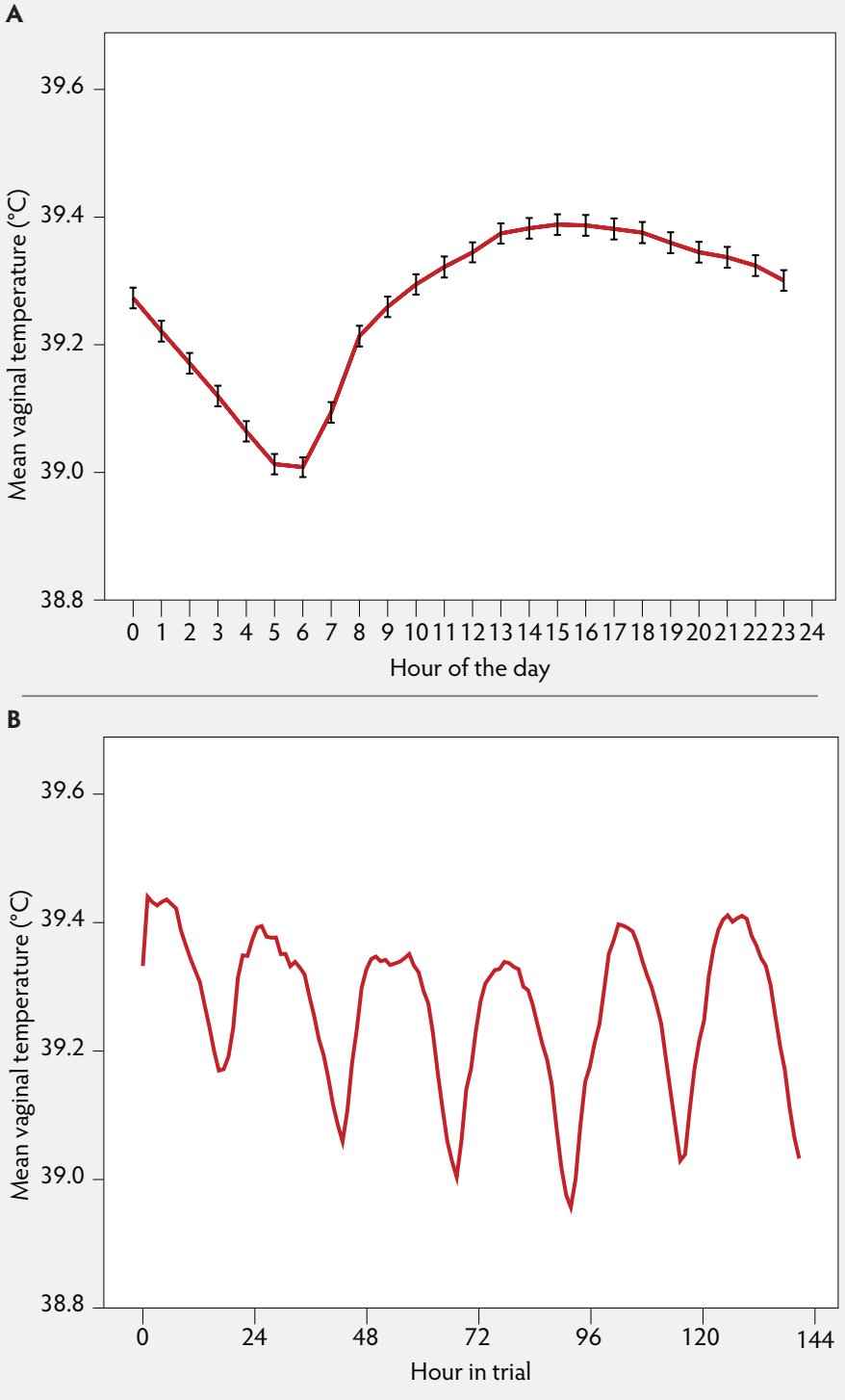
A total of 18 sows (9.0%) were treated within the first 6 days postpartum with dinoprost (n = 10, 5.0%) because of vaginal discharge or with antibiotic and anti-inflammatory drugs for 3 consecutive days as described (PPDS treatment; n = 8, 4.0%).

A total of 191 of the 199 study animals were inseminated after weaning. Seven of the remaining eight sows (4.0%) were slaughtered after weaning due to age (n = 3), lameness (n = 1), small litter size (n = 1), cachexia (n = 1), or infertility (n = 1). One sow died in the farrowing pen in the third week of lactation. Among 151 sows with vaginal temperature loggers, 146 sows became pregnant after the first insemination, and five sows after a second insemination. Among 40 sows without loggers, 39 sows became pregnant after the first insemination, and one sow after a second insemination. The logger had no effect on fertility after weaning ($P = 1.0$).

Factors associated with rectal temperature

In the univariate analysis, the influence of all plausible factors on rectal temperature was tested (Table 1). Medical treatment and PPDS treatment were correlated ($P = .65$) and therefore only PPDS treatment was included in the mixed model. Mean litter weight gain was excluded ($P = .35$). In the repeated measures linear mixed model (Table 1), the day post partum (1 to 6), time of day (morning or afternoon), age

Figure 1: In a study conducted on a commercial pig farm, January to May 2013, a total of 156 sows received a vaginal temperature logger for 6 days post partum and 43 sows did not receive a logger (negative control group). Vaginal temperature was measured at 10-minute intervals. Fifteen sows were excluded from vaginal temperature analysis because of logger losses or technical problems with the loggers. Mean vaginal temperature was measured for all sows for all study days (A, n = 141) and for days 1 to 6 post partum (B, n = 141).



(gilt, parity 2 to 4, parity ≥ 5), vaginal temperature logger (yes or no), general condition (healthy or slightly to severely reduced), vaginal discharge (yes or no), PPDS treatment (yes or no), and week of the study (1 to 16) remained significant (Figures 2, 3, 4, 5, and 6). The highest rectal temperature recorded from day 1 to 6 post partum was in gilts, whereas the lowest rectal temperature recorded throughout the trial was in sows of parity ≥ 5 (Table 2; Figure 3).

Factors associated with vaginal temperature

In a univariate analysis, all variables tested had an effect on vaginal temperature (Table 3). Litter weight on day 28 and the mean litter weight gain were correlated (r = .88), and therefore mean litter weight gain was excluded from further analysis. In the repeated measures linear mixed model (Table 3), day post partum (1 to 6), hour of day (1 to 24), age (gilt, parity 2 to 4, parity ≥ 5), feed intake (complete or partly to no intake), general condition (healthy or slightly to severely reduced), vaginal discharge (yes or no) and PPDS-treatment (yes or no) remained significant (Figures 1, 3, 5, and 6). The factor "age" was associated with vaginal temperature. Thus, the highest vaginal temperature recorded from day 1 to 6 post partum was in gilts, and the lowest vaginal temperature throughout the trial was in sows at parity ≥ 5 (Table 2, Figure 3).

Fever in postpartum sows

In summary, rectal temperature in the first 6 days post partum was > 39.5°C at least once in 59 of 199 sows (29.6%). Among these, 17 sows (8.5%) had a rectal temperature > 40.0°C. In 127 of 141 sows (90.1%), at least one vaginal temperature measurement was > 39.5°C, the threshold frequently used in previous studies.[1,6] Among these 127 sows, vaginal temperature was between 39.8°C and 40.0°C (68.8%), between 40.1°C and 40.3°C (61.7%), and > 40.3°C (40.4%) at least once in 97, 87, and 57 sows, respectively.

Table 1: Factors influencing rectal temperature in postpartum sows (n = 199)*

Factor	*P*	
	Univariable analysis	ANOVA
Day post partum	< .01	< .01
Time of day	< .01	< .01
Age (parity)	< .01	< .01
Vaginal temperature logger	< .01	.02
Liveborn piglets	.02	NS
Weight of piglets day 1	.16	NS
Weight of piglets day 28	.13	NS
Mean weight gain of piglets	.35	ND
Vaginal discharge	< .01	< .01
Feed intake	< .01	NS
General condition	< .01	< .01
Illness†	< .01	ND
PPDS treatment‡	< .01	< .01
Week of study	< .01	.03

* Study described in Figure 1. Vaginal temperature was measured at 10-minute intervals. Rectal temperature, feed intake, general condition, and vaginal discharge were evaluated daily. Effects of variables were tested using univariable analysis and repeated measures ANOVA in a multivariate linear mixed model. Piglets were weighed as a litter at 1 and 28 days of age. Litter weight was tested as a covariate.

† Assessment of illness was based on the combination of general behavior, feed intake, and vaginal discharge on at least 1 day of the 6-day trial.

‡ Enrofloxacin (Floxibac, 100 mg/mL; Chanelle Pharmaceuticals Manufacturing Ltd, Loughrea, Co Galway, Ireland), 50 mg/kg, IM, 3 consecutive days; metamizol (Metapyrin, 500 mg/mL; Serumwerk Bernburg AG, Bernburg, Germany), 50 mg/kg BW, IM, 3 consecutive days); and dinoprost (Dinolytic, 5 mg/mL; Zoetis Deutschland GmbH, Berlin, Germany), 10 mg IM, single injection first day of treatment.

ANOVA = analysis of variance; ND = not done; NS = not significant (*P* > .05); PPDS = postpartum dysgalactia syndrome; BW = body weight; IM = intramuscular.

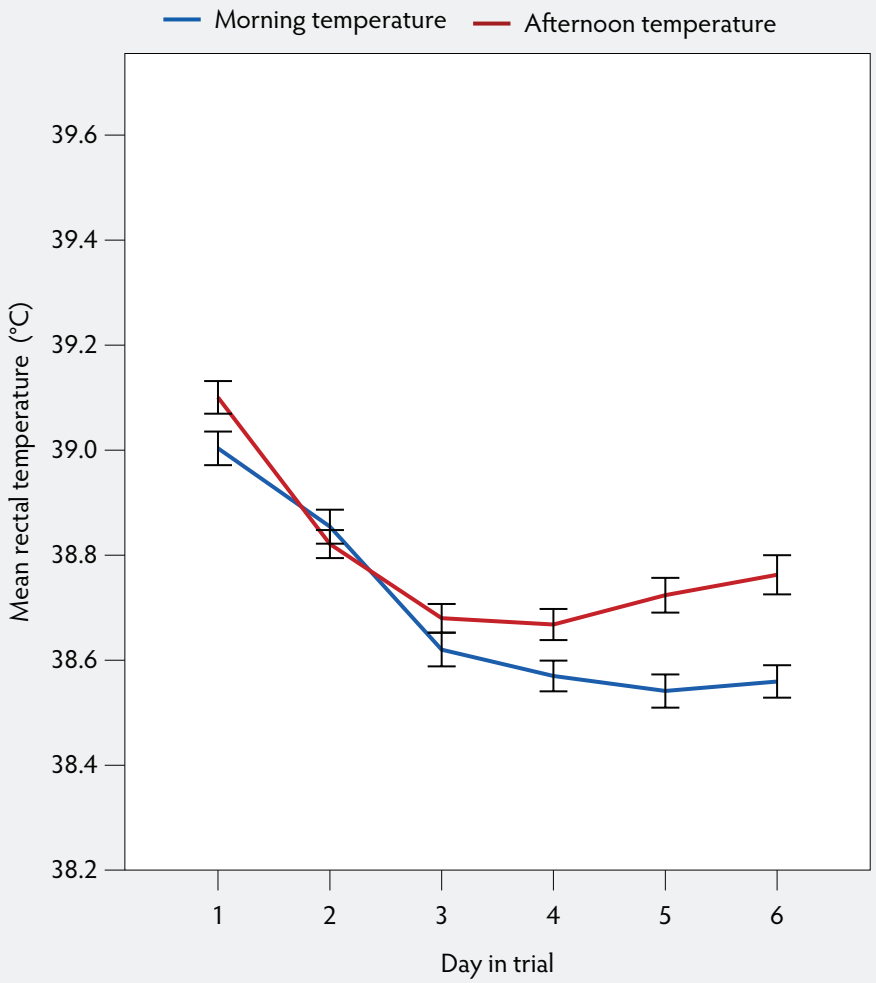
Discussion

A sufficient number of sows with a vaginal temperature logger (n = 156) were used in this study to examine the course of continuously measured vaginal temperature, because information on rectal temperature based on repeated measures at certain time points is already available.[19] In former studies, temperature sensors for measuring body temperature were often inserted under general anesthesia, eg, near the carotid artery[20] or the femoral or pulmonary artery, in the urinary bladder, or by the tympanic method,[21] and animals were housed under laboratory conditions.[9,15] In this study, temperature loggers inserted into the vagina allowed continuous recording of vaginal temperature under field conditions, as recently validated for cows and sows.[13,14] Previous trials used only three,[22] nine,[9] 27,[23] or 43 animals.[15] Furthermore, a larger number of sows (n = 141), including gilts (n = 28) were used in this study to investigate the effect of plausible factors on vaginal temperature. The loggers were attached to a modified vaginal CIDR device as described for cows, dogs, and sows.[12,14,24] This minimized expulsion of loggers from the vagina during the study period (10 loggers; 6.4%), while in another study, loggers were not fixed in the vagina and slid out easily.[15] In the current study, insertion of the loggers was minimally invasive and did not require anaesthesia. To the knowledge of the authors, this is the first study using this methodology in sows for 6 days post partum.

Vaginal temperatures showed a clear circadian rhythm. It can be speculated that the minimum temperature in the morning was interrupted by starting of activities in the farrowing room, eg, feeding. In the afternoon, body temperature decreased more slowly because of thermal storage and physiological activity of the sow.

A similar circadian temperature rhythm

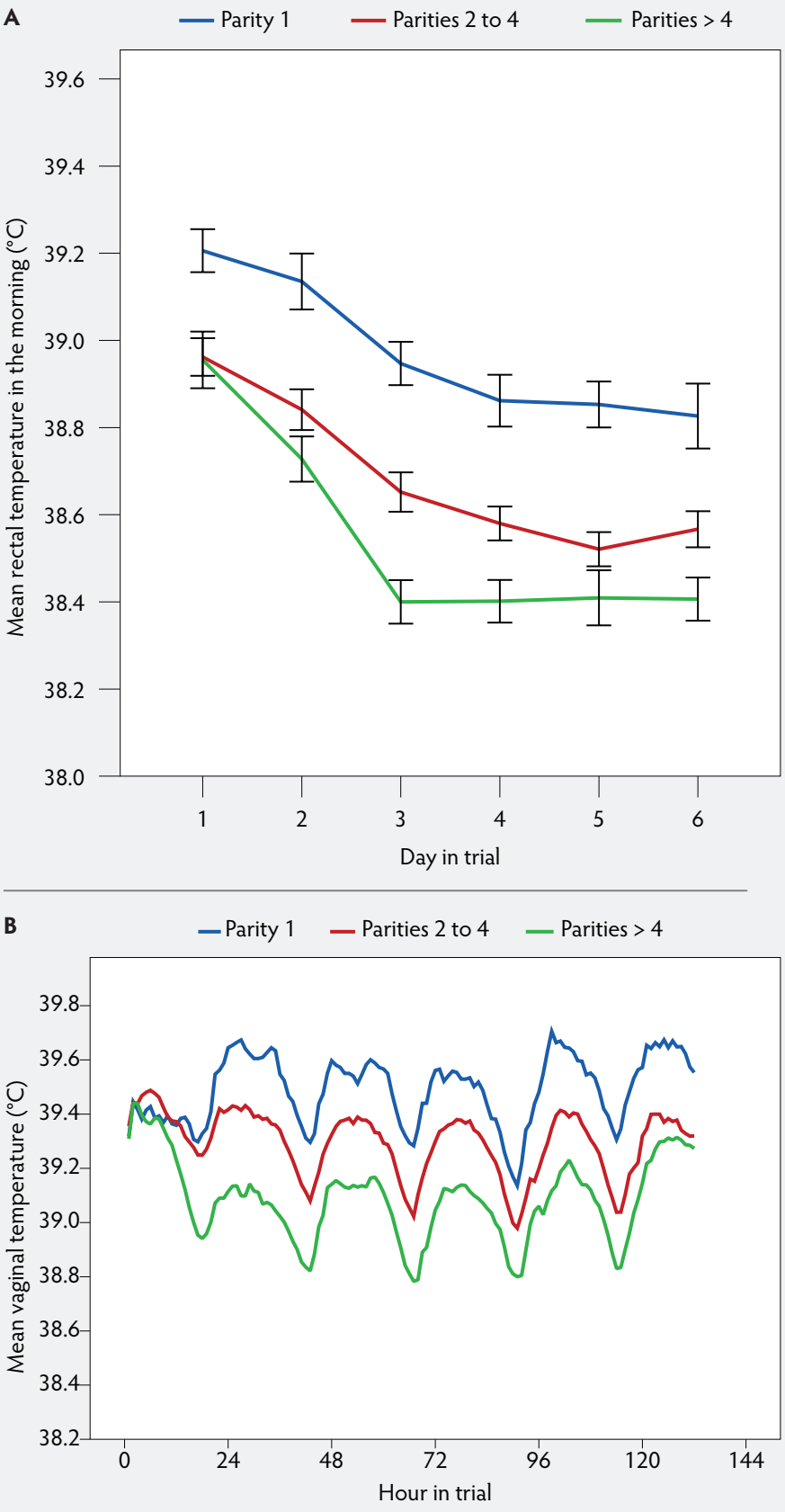
Figure 2: Mean rectal temperature (± standard error of the mean) measured morning and afternoon in postpartum sows (n = 199). Study described in Figure 1 and Table 1.



has been described previously.[9] In a small study, body temperature in eight of nine growing-finishing swine exhibited a circadian rhythm with an amplitude (range between the lowest and highest values of mean temperature) of 0.18°C ± 0.02°C, mean body temperature of 38.7°C ± 0.24°C, and a maximum at 7:44 PM.[9] However, on the basis of frequent body temperature measurements by a temperature transmitter at 30-minute intervals in 10- to 14-week-old pigs for 2 to 3 consecutive days, it was concluded that in pigs there is a very little innate circadian rhythm and that the observed temperature variations are mainly related to feeding and activity.[23] In the present study, a circadian rhythm in sows was observed during the first 6 days post partum with an amplitude of 0.4°C. It was not possible, however, to determine whether this variation was based on an innate circadian rhythm or related to feeding or activity or both.

Infections, trauma, and injury result in an adaptive response that includes loss of appetite, apathy, and fever.[25] Fever is triggered by the release of endogenous pyrogens from different regions of macrophage-like cells. These pyrogens include cytokines IL-1 and IL-6, which act at the level of the anterior hypothalamus to raise the thermoregulatory set point. In a previous study,[1] it was suggested that it is possible to predict the occurrence of PPDS from elevation of rectal temperature, which occurs earlier than other clinical signs (eg, vaginal discharge, mastitis, or emaciated piglets as a consequence of insufficient milk production). It was postulated that rectal temperature > 39.4°C was an appropriate threshold to administer preventive medical treatment such as antibiotic and anti-inflammatory drugs.[1] A previous publication demonstrated a physiological hyperthermia after farrowing.[8] In this study, 59 (29.6%) and 17 (8.5%) of 199 sows had rectal temperatures > 39.5°C and > 40.0°C, respectively, and 57 (40.4%) sows had vaginal temperatures > 40.3°C. Only eight of these sows received antibiotic and anti-inflammatory treatment. Most of the sows with such high temperatures showed no signs of illness, eg, apathy, no feed intake, or vaginal discharge, and were therefore not treated. As evidenced by the subsequent reproductive performance of the sows, these high body temperatures might not have negative consequences. However, this fact needs to be studied on a large scale with more sows and more farms. In the study of Elmore et al,[26] mean pre-farrowing body temperature of 12 mixed-breed sows was 38.83°C ± 0.3°C. Mean postfarrowing temperature was 0.6°C to 1.2°C higher and temperature returned to pre-farrowing values after piglets were weaned. These investigators measured body temperature with surgically implanted temperature transmitters in the left paralumbar fossa. King et al[19] also demonstrated that sows have a significantly higher rectal temperature after farrowing (39.3°C ± 0.7°C) than before farrowing (38.3°C ± 0.6°C). Their study was conducted on 217 sows in which rectal temperature was measured three times a day. The authors speculated that the higher temperatures were caused by the physiological inflammatory reaction accompanying involution of the uterus and increasing mammary gland metabolism. Interestingly, they also postulated that healthy sows may have a body temperature > 39.7°C and that high rectal temperature without other clinical signs should not be considered evidence of disease.[19] Our results are in agreement, ie, in a high number of apparently healthy sows, body temperature exceeded 39.5°C, the common threshold for pyrexia. In the study of King et al,[19] a glass mercury thermometer was used, whereas we used a digital thermometer. The comparison must be interpreted with care, as it is possible that use of different methods of measuring rectal temperature biased the results. To date, it is an accepted fact that lactation hyperthermia occurs in sows after farrowing,[8] hence the difficulty in defining body temperature limits for medical treatment of sows. The results of this study provide further evidence that diagnosis of PPDS in sows should include a combination

Figure 3: Mean rectal temperature (± standard error of the mean) measured in the morning (A) and mean vaginal temperature measured continuously (B) in postpartum sows. Parity 1, rectal temperature, n = 34, vaginal temperature, n = 28; Parity 2-4, rectal temperature, n = 100, vaginal temperature, n = 71; Parity > 4, rectal temperature, n = 65, vaginal temperature, n = 42. Study described in Figure 1 and Table 1.



of clinical signs, eg, lethargy, diminished milk production, reduced appetite, and vaginal discharge, as previously described.[27] It is emphasized, however, that evaluation of clinical signs might be more subjective than measurement of rectal temperature, which is a repeatable measure.[14] This has already been demonstrated for vaginal discharge in cows.[28] General health condition, feed intake, and vaginal discharge are subjective parameters, but more objective parameters to validate health or illness of early postpartum sows are limited. Clinical examination of the study animals was conducted only by the investigator to reduce observer bias. In addition, during the first 2 weeks of the study and every Thursday, clinical examinations were performed simultaneously by the herd manager and the first author to provide a consistent evaluation of these parameters. Furthermore, assessments of feed intake, vaginal discharge, and general demeanour are similar to those used in a previous PPDS study as clinical parameters in examination of sows.[6]

In this study, general behavior, feed intake, and vaginal discharge had a significant influence on rectal and vaginal temperature. Gilts had higher rectal and vaginal temperatures than older sows from day 1 to 6. This result agrees with that of a previous study in cows.[29] To the knowledge of the authors, this has not yet been described for sows. The number of piglets born alive, mean litter weight on day 1, mean weight gain, and mean litter weight on day 28 did not influence vaginal and rectal temperatures. These findings agree with those of another study.[30] Insertion of a vaginal temperature logger affected rectal temperature. This could be explained as a physiologic reaction to a foreign body.

It remains unclear if the factors used as covariates occurred as a consequence of, or simultaneously with, higher body temperature (eg, illness, medical treatment). However, in these models, this is of minor consequence because both models seek large-scale associations.

Measuring rectal temperature is an objective and repeatable diagnostic method.[14] The measuring process, however, should be standardized to achieve comparable values. Temperature should be measured at the same time of day. The results of this study clearly illustrated that the measures should be interpreted with caution, because rectal and vaginal temperature are associated with

several factors. Body temperature is only one sign of the PPDS complex and should not be used as the single criterion for the decision to administer medical treatment in early postpartum sows. General health status, feed intake, and vaginal discharge are more subjective, and their usefulness should be evaluated in combination with body temperature in further studies. It must be emphasized that the definition of PPDS needs refinement.

Implications

- Because of the circadian rhythm of body temperature in sows, measurements should be made at the same time every day.
- Use of temperature loggers inserted into the vagina of sows is very practicable for on-farm studies to gain more information about postpartum body temperature.
- Clinical signs such as general behaviour, feed intake, and vaginal discharge are associated with increased body temperature in sows.
- Body temperature should not be used as the single criterion for the decision to administer medical treatment in early postpartum sows.

Conflict of interest

None reported.

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Figure 4: Mean rectal temperature (± standard error of the mean) measured in the morning (A) and in the afternoon (B) in postpartum sows with (n = 141) and without (n = 43) vaginal temperature loggers. Study described in Figure 1 and Table 1.

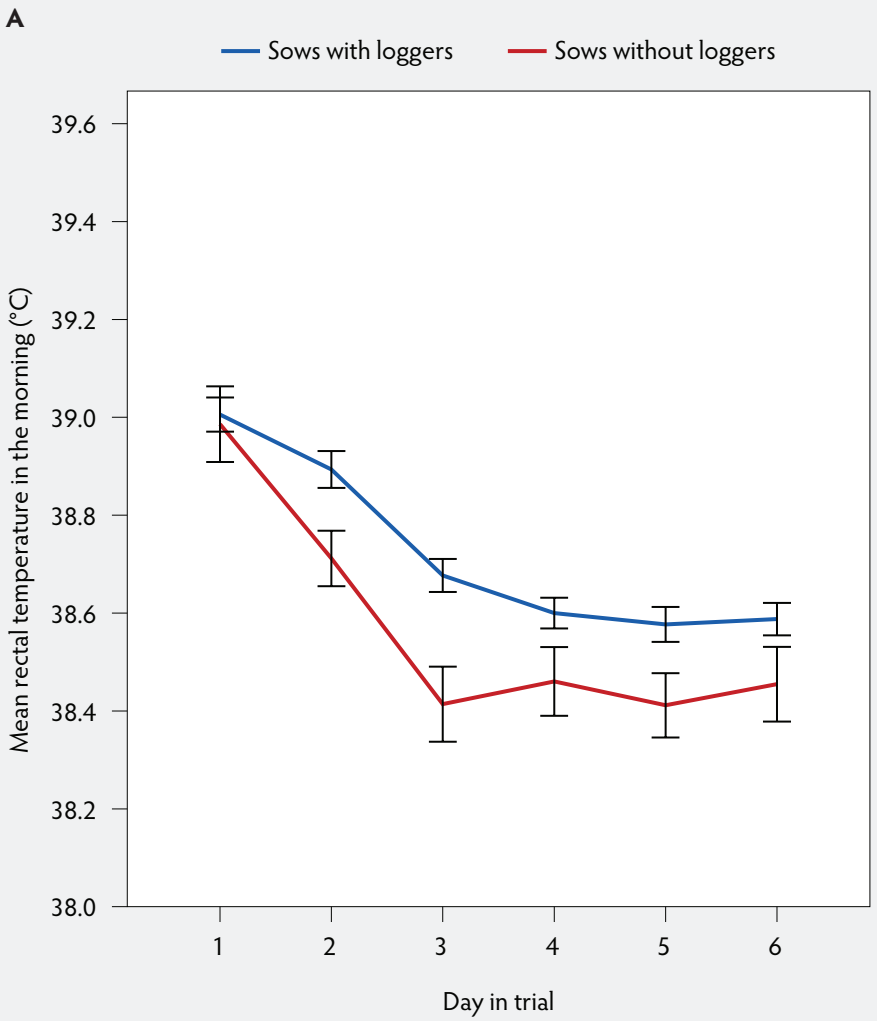

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Figure 4: Mean rectal temperature (± standard error of the mean) measured in the morning (A) and in the afternoon (B) in postpartum sows with (n = 141) and without (n = 43) vaginal temperature loggers. Study described in Figure 1 and Table 1.

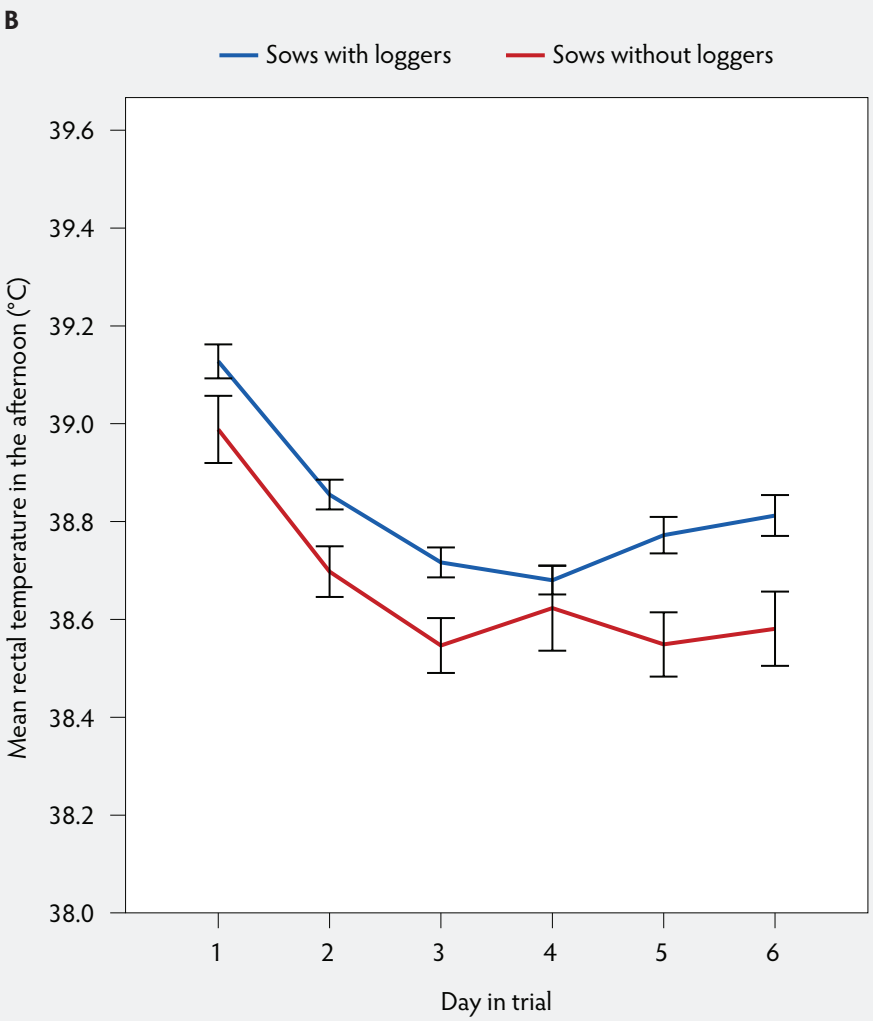

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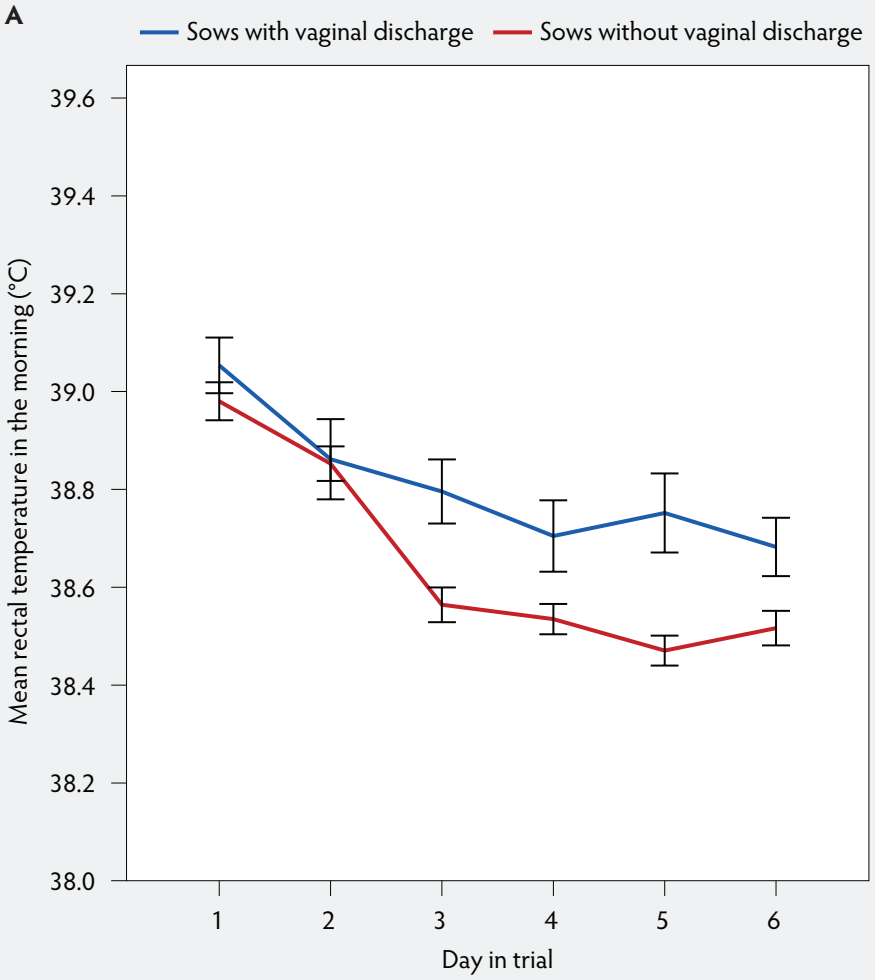
Figure 5: Mean rectal temperature (± standard error of the mean) measured in the morning (A) and mean vaginal temperature measured continuously (B) in postpartum sows with vaginal discharge (rectal temperature, n = 58; vaginal temperature, n = 33) and without vaginal discharge (rectal temperature, n = 141; vaginal temperature, n = 108).



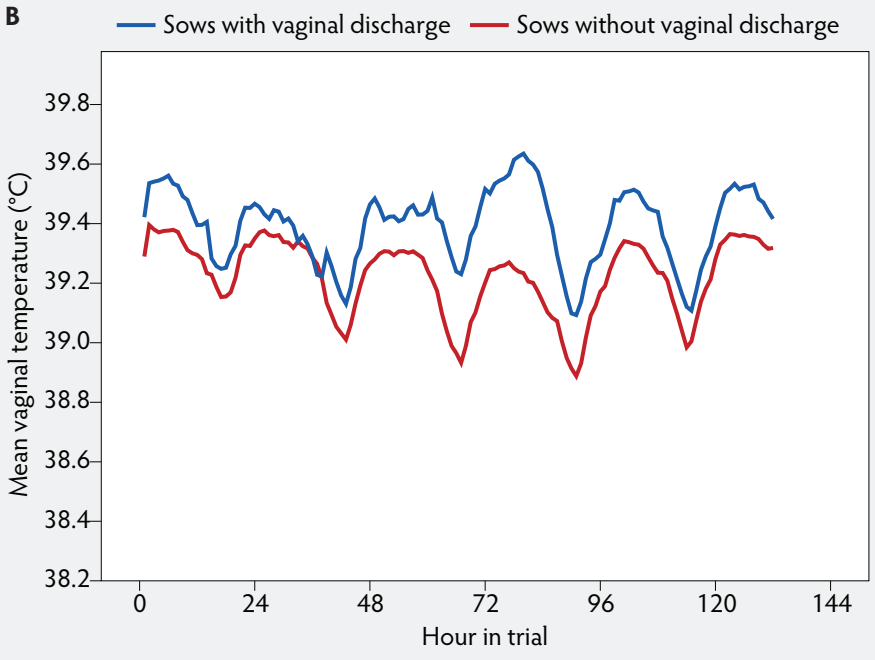


Figure 6: Mean rectal temperature (± standard error of the mean) measured in the morning (A) and vaginal temperature measured continuously (B) in sows treated for postpartum dysgalactia (PPDS) (rectal temperature, n = 8; vaginal temperature, n = 7) and sows not treated for PPDS (rectal temperature, n = 191; vaginal temperature, n = 134). PPDS treatment described in Table 1.

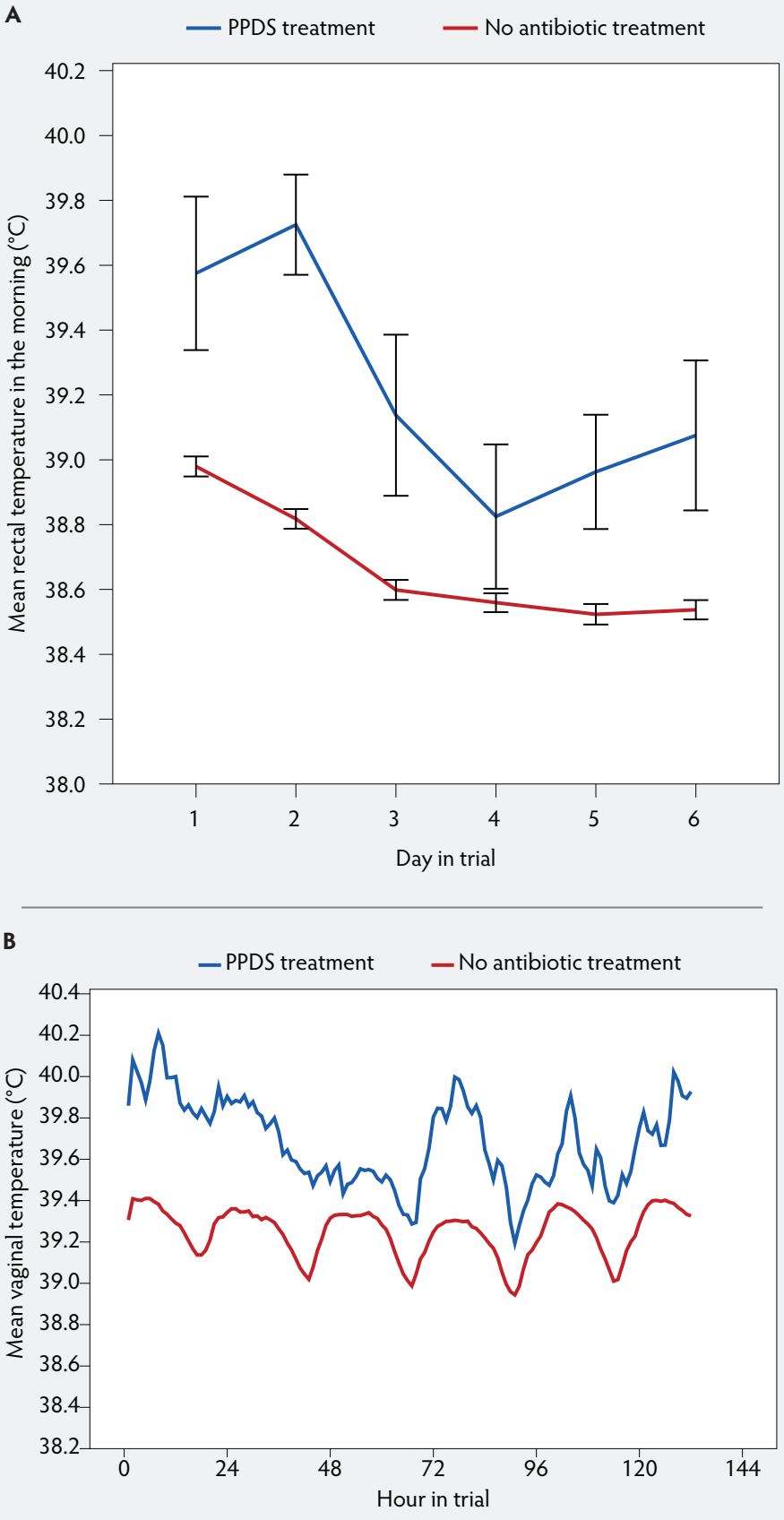


Table 2: Rectal and vaginal temperatures in °C (mean ± standard deviation) in postpartum sows by parity (n = 199)*

Parity	Temperature measurement	Days postpartum					
		1	2	3	4	5	6
All n = 199	RTAM (°C)	39.0 ± 0.5^{a}	38.9 ± 0.5^{b}	38.6 ± 0.5^{c}	38.6 ± 0.4^{cd}	38.5 ± 0.4^{d}	38.6 ± 0.4^{cd}
	RTPM (°C)	39.1 ± 0.4^{a}	38.8 ± 0.4^{b}	38.7 ± 0.4^{cd}	38.7 ± 0.4^{cd}	38.7 ± 0.5^{cde}	38.8 ± 0.5^{be}
	VT (°C)	39.4 ± 0.5^{a}	39.3 ± 0.5^{b}	39.3 ± 0.4^{c}	39.2 ± 0.5^{d}	39.2 ± 0.5^{d}	39.3 ± 0.5^{e}
1 n = 34	RTAM (°C)	39.2 ± 0.3^{a}	39.1 ± 0.4^{a}	38.9 ± 0.3^{b}	38.9 ± 0.3^{bd}	38.9 ± 0.3^{cd}	38.8 ± 0.4^{cd}
	RTPM (°C)	39.2 ± 0.2^{a}	39.1 ± 0.3^{b}	39.0 ± 0.3^{cd}	38.9 ± 0.4^{c}	38.9 ± 0.4^{c}	39.1 ± 0.4^{bd}
	VT (°C)	39.4 ± 0.3^{a}	39.5 ± 0.5^{bc}	39.5 ± 0.4^{c}	39.5 ± 0.3^{d}	39.5 ± 0.4^{d}	39.5 ± 0.5^{b}
2-4 n = 100	RTAM (°C)	39.0 ± 0.4^{a}	38.8 ± 0.5^{b}	38.7 ± 0.4^{c}	38.6 ± 0.4^{d}	38.5 ± 0.4^{d}	38.6 ± 0.4^{d}
	RTPM (°C)	39.1 ± 0.4^{a}	38.8 ± 0.4^{b}	38.7 ± 0.4^{cd}	38.7 ± 0.4^{c}	38.7 ± 0.4^{de}	38.8 ± 0.5^{e}
	VT (°C)	39.4 ± 0.5^{a}	39.4 ± 0.5^{b}	39.3 ± 0.4^{c}	39.3 ± 0.5^{c}	39.2 ± 0.5^{de}	39.3 ± 0.5^{ce}
> 4 n = 65	RTAM (°C)	39.0 ± 0.5^{a}	38.7 ± 0.4^{b}	38.4 ± 0.4^{c}	38.4 ± 0.4^{c}	38.4 ± 0.5^{c}	38.4 ± 0.4^{c}
	RTPM (°C)	39.1 ± 0.6^{a}	38.7 ± 0.3^{b}	38.5 ± 0.3^{c}	38.6 ± 0.5^{bc}	38.6 ± 0.5^{b}	38.6 ± 0.5^{bc}
	VT (°C)	39.4 ± 0.5^{a}	39.1 ± 0.4^{bc}	39.1 ± 0.4^{bc}	39.0 ± 0.4^{d}	39.0 ± 0.4^{bcd}	39.1 ± 0.5^{e}

* Study described in Figure 1 and Table 1. Vaginal temperatures were recorded continuously using a vaginal temperature logger.

^{abcde} Means within a row with different superscripts differ ($P < .05$; repeated measures analysis of variance).

RTAM = rectal temperature measured in the morning; RTPM = rectal temperature measured in the afternoon; VT = vaginal temperature measured continuously using temperature logger (24-hour average).

Table 3: Factors influencing vaginal temperature in postpartum sows (n = 141)*

Factor	*P*	
	Univariable analysis	Repeated measures ANOVA
Day post partum	< .01	< .01
Time of day	< .01	< .01
Age (parity)	< .01	< .01
Liveborn piglets	.02	NS
Weight of piglets at day 1	< .01	NS
Weight of piglets at day 28	< .01	NS
Mean weight gain of piglets	< .01	ND
Vaginal discharge	< .01	< .01
Feed intake	< .01	< .01
General condition	< .01	< .01
Illness†	< .01	NS
PPDS treatment	< .01	< .01
Week of study	< .01	NS

* Study, statistical analysis, and PDDS treatment described in Figure 1 and Table 1.

† Illness based on the combination of general behavior, feed intake, or vaginal discharge on at least 1 day of the 6-day trial.

PPDS = postpartum dysgalactia syndrome; NS = not significant ($P > .05$); ND = not done.

Evaluation of time and temperature sufficient to inactivate porcine epidemic diarrhea virus in swine feces on metal surfaces

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Summary

Objectives: To determine temperature and time applications sufficient to inactivate porcine epidemic diarrhea virus (PEDV) on a commercial livestock trailer, and practical within the constraints of current thermo-assisted drying and decontamination (TADD) capabilities in the industry.

Materials and methods: Thirty-two 4-week-old barrows were inoculated via oral gastric tube with 5 mL of either PEDV-negative feces (Neg; n = 4), untreated PEDV-positive feces (Pos; n = 4), or PEDV-positive feces subjected to 71°C for 10 minutes (71C-10M; n = 4), 63°C for 10 minutes (63C-10M; n = 4), 54°C for 10 minutes (54C-10M; n = 4), 38°C for 12 hours (38C-12H; n = 4), 20°C for 24 hours (20C-24H; n = 4), or 20°C for 7 days (20C-7D; n = 4). These pigs served as a bioassay to determine the infectivity of virus following treatment. Bioassay results were determined by reverse-transcriptase polymerase chain reaction on rectal swabs collected from the inoculated pigs on days 3 and 7 post inoculation.

Results: None of the pigs in the 71C-10M and 20C-7D groups became infected with PEDV. This result differed significantly from that of the Pos group ($P < .05$). Results of the other groups did not differ significantly from that of the Pos group ($P > .05$).

Implication: Holding PEDV in the presence of feces at 71°C for 10 minutes or at 20°C (room temperature) for 7 days is sufficient to inactivate the virus, preventing transmission under the conditions of this study.

Keywords: swine, porcine epidemic diarrhea virus, inactivation, temperature, thermo-assisted drying and decontamination

Received: August 19, 2014
Accepted: October 21, 2014

Resumen - Evaluación del tiempo y temperatura suficientes para inactivar el virus de la diarrea epidémica porcina en las heces fecales porcinas en superficies metálicas

Objetivos: Determinar la aplicación de temperatura y tiempo suficientes para inactivar el virus de la diarrea epidémica porcina (PEDV por sus siglas en inglés) en un camión de transporte de ganado, y aplicables dentro de las limitaciones de la capacidad actual de descontaminación y secado termo asistido (TADD por sus siglas en inglés) presentes en la industria.

Materiales y métodos: Se inocularon treinta y dos cerdos castrados de 4 semanas de edad vía un tubo gástrico oral con 5 mL de heces negativas al PEDV (Neg; n = 4), heces positivas al PEDV no tratado (Pos; n = 4), o heces positivas al PEDV sometidas a 71°C por 10 minutos (71C-10M; n = 4), 63°C por 10 minutos (63C-10M; n = 4), 54°C por 10 minutos (54C-10M; n = 4), 38°C por 12 horas (38C-12H; n = 4), 20°C por 24 horas (20C-24H; n = 4), o 20°C por 7 días (20C-7D; n = 4). Estos cerdos sirvieron como un bioensayo para determinar la infectividad del virus después del tratamiento. Los resultados del bioensayo se determinaron por medio de la reacción en cadena de polimerasa de transcriptasa reversa en muestras de hisopos rectales recolectadas los días 3 y 7 post inoculación de los cerdos inoculados.

Resultados: Ninguno de los cerdos en los grupos 71C-10M y 20C-7D se infectaron con PEDV. Este resultado difirió significativamente del resultado del grupo Pos ($P < .05$). Los resultados de los otros grupos no difirieron significativamente del resultados del grupo Pos ($P > .05$).

Implicación: Mantener el PEDV en la presencia de heces a 71°C por 10 minutos o a 20°C (a temperatura ambiente) por 7 días es suficiente para inactivar el virus, previniendo la transmisión bajo las condiciones de este estudio.

Résumé - Évaluation du temps et de la température suffisants pour inactiver le virus de la diarrhée épidémique porcine dans des fèces de porc sur des surfaces métalliques

Objectifs: Déterminer les températures et les temps de contact suffisants pour inactiver le virus de la diarrhée épidémique porcine (VDEP) sur une remorque commerciale servant au transport des animaux, tout en étant pratique compte tenu des contraintes

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

Thomas PR, Karriker LA, Ramirez A, et al . Evaluation of time and temperature sufficient to inactivate porcine epidemic diarrhea virus in swine feces on metal surfaces. *J Swine Health Prod.* 2015;23(2):84–90.

associées aux capacités de l'industrie porcine en ce qui a trait au séchage thermo-assisté et à la décontamination (TADD).

Matériels et méthodes: Trente-deux mâles castrés âgés de 4 semaines ont été inoculés oralement via un tube gastrique avec 5 mL de fèces négatives pour VDEP (Nég; n = 4), de fèces VDEP positives non-traitées (Pos; n = 4), ou de fèces VDEP positives soumises à une température de 71°C pour 10 minutes (71C-10M; n = 4), 63°C pour 10 minutes (63C-10M; n = 4), 54°C pour 10 minutes (54C-10M), 38°C pour 12 heures (38C-12H; n = 4), 20°C pour 24 heures (20C-24H; n = 4), ou 20°C pour 7 jours (20C-7D; n = 4). Ces porcs ont servi de bio-essai afin de déterminer le pouvoir infectieux du virus suite au traitement. Les résultats du bio-essai ont été déterminés par réaction d'amplification en chaîne par la polymérase à l'aide de la transcriptase réverse sur des écouvillons rectaux prélevés des porcs inoculés aux jours 3 et 7 post-inoculation.

Résultats: Aucun des porcs des groupes 71C-10M et 20C-7D n'est devenu infecté avec le VDEP. Ce résultat différait significativement de ceux du groupe Pos ($P < 0,05$). Les résultats des autres groupes n'étaient pas significativement différents de ceux du groupe Pos ($P > 0,05$).

Implication: Le maintien du VDEP en présence de fèces à 71°C pour 10 minutes ou à 20°C (température ambiante) pendant 7 jours est suffisant pour inactiver le virus, prévenant ainsi la transmission dans les conditions de la présente expérimentation.

Porcine epidemic diarrhea (PED) was first described in England in 1971 in growing pigs,[1] and the causative agent, porcine epidemic diarrhea virus (PEDV), was identified in 1978.[2,3] The virus spread to the rest of Europe where it caused outbreaks of diarrhea and significant losses throughout the 1970s and 1980s.[4,5] Porcine epidemic diarrhea virus is considered endemic to Europe today, but does not cause widespread significant disease. In parts of Asia, outbreaks were recognized first in 1982 and have continued to occur since.[4,5] Until recently, the virus was considered to be absent from the western hemisphere.[5,6] In May of 2013, PEDV was identified in swine in the United States for the first time. The virus has caused severe diarrhea in sows and piglets, with near 100% mortality in piglets across a wide geographical area of the United States.[6] Outbreaks of PED continue to occur in the United States, with over 6000 PEDV-positive accessions reported from 29 states as of May 2014.[7] Genetic analyses of PEDV isolates from affected farms in the United States found the virus to be 99% genetically similar to isolates from China.[8-10] Subsequent genetic analysis of PEDV isolates revealed the presence of two genetically distinct viruses in the United States.[11] Viral cluster analysis suggests both isolates originated in China, but efforts to determine the source of entry to the United States have been unsuccessful.

Although the original mode of entry of PEDV into the United States remains unknown, contaminated livestock trailers certainly represent a significant risk for movement of the virus between and within herds.[12] This is true of other swine diseases as well, including porcine reproductive and respiratory syndrome virus (PRRSV)[13] and transmissible gastroenteritis virus (TGEV).[4] Historically, the disease risk posed by contaminated trailers has been effectively mitigated in some cases with the use of trailer washing, disinfection protocols, and thermo-assisted drying and decontamination (TADD) systems.[14] Considering the effectiveness of TADD systems to control these other diseases, and the structural similarity of PEDV to TGEV, TADD may be an efficacious means of inactivating PEDV in contaminated livestock trailers.

The objective of this study was to investigate a range of time and temperature combinations to determine if they are sufficient to inactivate PEDV in swine feces on metal surfaces similar to those found in livestock trailers.

Materials and methods

The experimental protocol was approved by the Iowa State University Institutional Animal Care and Use Committee prior to the initiation of any experimental activity.

Source of animals and housing

Thirty-two 3-week-old, clinically healthy barrows were sourced from a private commercial producer in Iowa. At 72 hours after arrival, blood was collected from each pig via jugular venipuncture using a 12-mL syringe with an 18-gauge, 1.5-inch needle (Monoject; Covidien, Mansfield, Massachusetts) then transferred to an 8.5-mL plastic serum separator tube (BD Vacutainer, 8.5-mL draw; Becton, Dickinson and Company, Franklin Lakes, New Jersey). Blood was centrifuged at 2100*g* for 10 minutes and the serum portion was split into two aliquots and dispensed into two separate 5-mL snap cap tubes (BD Falcon polypropylene round-bottom tube; Becton, Dickinson and Company). One aliquot was frozen and stored at -80°C as a duplicate. Fecal samples were collected using a commercial swab and transport system (Starswabs II; Starplex Scientific Inc, Etobicoke, Ontario, Canada). Serum and fecal samples were submitted to Iowa State University Veterinary Diagnostic Laboratory (ISU VDL) for diagnostic testing. Pigs were negative for PEDV and TGEV (testing fecal samples) and PRRSV (testing serum samples) using virus-specific reverse-transcriptase polymerase chain reaction (RT-PCR) assays. All animals were positive for porcine rotavirus via PCR. Animals were PEDV-naive by serum immunofluorescent antibody testing.

On arrival, each pig was identified with a unique plastic livestock ear tag (Allflex USA, Dallas, Texas) and weighed. Following a 72-hour rest period and initial screening as described above, pigs were blocked by weight into four blocks of eight pigs each. One pig from each block was then randomly assigned to each of eight different groups using the RAND function in Excel (Microsoft Corporation, Redmond, Washington). Each group was housed in a separate room in the Iowa State University Veterinary Medical Research Institute for the duration of the study. The four pigs within each group were housed individually in elevated tubs (Figure 1). Each tub was constructed with solid dividers, completely separating pigs from one another. One of the dividers in each tub was transparent to allow each pig visual contact with one other pig. Each divided portion of the tub had dedicated water and feed sources.

Pigs were fed ad libitum an age-appropriate diet based on corn and soybean meal and free of medications. Feces fell through the plastic slatted flooring of the tub into a common collection area below the pigs, where it fell into a holding container with water and detergent to contain feces and PEDV particles and thus reduce the potential for environmental contamination.

Study design

Combinations of time and temperature evaluated included 71°C for 10 minutes (71C-10M), 63°C for 10 minutes (63C-10M), 54°C for 10 minutes (54C-10M), 38°C for 12 hours (38C-12H), 20°C for 24 hours (20C-24H), and 20°C for 7 days (20C-7D). In addition, a positive control group (Pos) and negative control group (Neg) underwent no time interval or temperature treatment. Prior to exposure to the designated combinations of temperature and time, aluminum trays were covered with feces to simulate a contaminated livestock trailer. The Neg group utilized PEDV-negative feces; all other groups utilized PEDV-positive feces obtained as described. Treatment groups are summarized in Table 1.

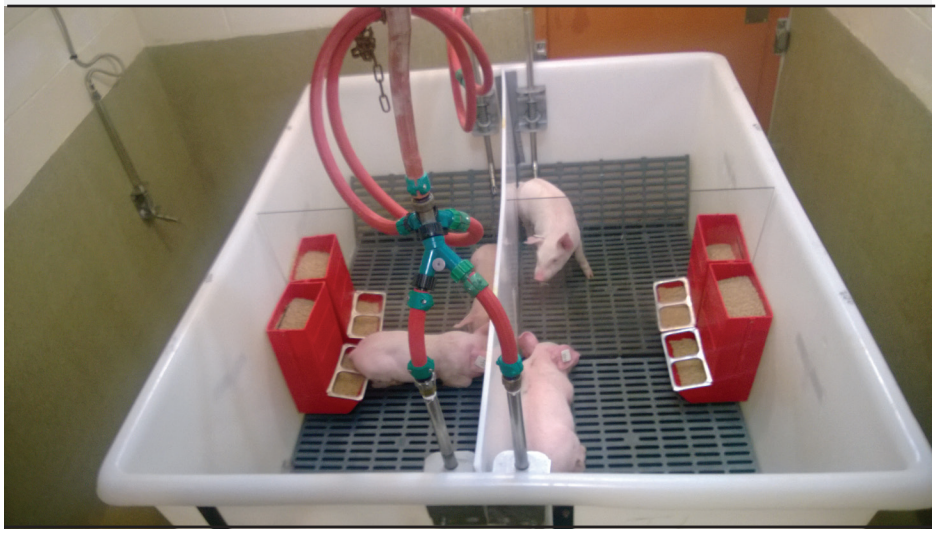
The experimental unit was the individual pig. For the bioassay, the inoculum for each pig was prepared using a single aluminum tray dedicated to that pig. The tray was contaminated with feces and then exposed to the designated combinations of temperature and time.

Challenge material

Challenge material was obtained from a separate study in which 3-week-old pigs were either challenged with PEDV or left unchallenged. Forty-eight hours following challenge, when pigs were expected to be at peak virus shedding, the pigs were euthanized and feces were collected both ante and post mortem. Feces from the challenged pigs only were pooled and homogenized to ensure uniform challenge material. After pooling, PEDV-positive feces were split into 5-mL aliquots and stored in 15-mL cone-bottom centrifuge tubes (15-mL Sterile Polypropylene Disposable Centrifuge Tube; Fisher Scientific, Pittsburgh, Pennsylvania) so that each treatment-replicate would have a dedicated sample. The samples were placed on ice until they could be frozen at -80°C approximately 1 hour later. Additional aliquots were obtained for the purpose of assessing the handling and storage process if necessary. One sample was tested via RT-PCR at the ISU VDL prior to freezing to confirm the PEDV-positive status of the feces. This sample was PEDV-positive with a cycle threshold (Ct) value of 10.5.

Feces negative for PEDV were obtained in the same way from the unchallenged pigs and were also split into sufficient aliquots to allow for treatment and testing needs. One aliquot of PEDV-negative feces was tested via PEDV RT-PCR at the time of collection to confirm the PEDV-negative status of the feces. This fecal sample was PEDV-negative with a reported Ct value of > 40.

Figure 1: Elevated tubs used to house pigs for the duration of a study evaluating the ability of different combinations of time and temperature to inactivate porcine epidemic diarrhea virus (PEDV) on metal surfaces similar to those found in livestock trailers. One tub was located in each room. Each tub was split into quarters with one pig per quarter. Design of the tub prevented contact between pigs and movement of feces or other waste between tub quarters. Swine bioassays were used to determine infectivity of virus in the challenge material, and polymerase chain reaction (PCR) of day 3 and day 7 rectal swabs was used to determine bioassay status. The experimental unit was the individual pig, with four pigs per treatment group. Challenge material was prepared using a single aluminum tray, dedicated to one pig, that was contaminated with feces to replicate a contaminated livestock trailer and then exposed to the designated combinations of temperature and time. The Neg group utilized PEDV-negative feces; the other seven groups utilized PEDV-positive feces. Combinations of time and temperature evaluated included 71°C for 10 minutes, 63°C for 10 minutes, 54°C for 10 minutes, 38°C for 12 hours, 20°C for 24 hours, and 20°C for 7 days. In addition, the positive control group (Pos) and negative control group (Neg) underwent no time interval or temperature treatment. Treatment groups are described in Table 1.



Time and temperature treatment

Prior to treatment, 5 mL PEDV-positive feces was applied to an aluminum tray (Figure 2) custom made to replicate a commercial hog trailer floor. Feces were spread in a thin (≤ 2 mm), even, liquid layer using a disposable, flat adhesive spreader. A separate dedicated spreader was used for each tray to avoid cross-contamination between replicates. After application of feces, the trays were individually sampled and tested by PCR to confirm the presence or absence of PEDV RNA prior to the timed temperature treatment.

The treatment was applied to all replicates (n = 4) of a treatment group simultaneously. For treatment groups 71C-10M, 63C-10M, 54C-10M, and 38C-12H, controlled exposure to the designated combination of time and temperature was accomplished using a Fisher Scientific Isotemp Incubator (Fisher Scientific). The incubator was pre-heated to the target temperature for each group prior to placing the trays in the incubator. The surface temperature of the trays was monitored using a Fluke model 53-2-B thermometer with a Fluke model 80PK-1 Type-K bead probe thermocouple (Fluke Corporation, Everett, Washington). Once the average temperature of the four trays had reached the target temperature, timing began.

For treatment groups 20C-24H and 20C-7D, controlled exposure to the designated combinations of time and temperature was accomplished by placing the trays in an insulated cooler that was maintained indoors at room temperature (20°C). The coolers served to insulate the trays from wide variations in temperature that might occur during the diurnal cyclic warming and cooling of the building environment. Temperatures in

Table 1: Time and temperature treatment groups evaluated for their ability to inactivate PEDV on metal surfaces, and the field conditions they simulate *

Treatment name and description	Simulates
Neg	
No treatment, gavage of PEDV-negative feces	Negative control
Pos	
No treatment, gavage of PEDV-positive feces	Positive control
71C-10M	
Heated to 71°C in an incubator, held at 71°C for 10 minutes†	Heating via TADD‡ to a temperature of 71°C, held at 71°C for 10 minutes§
63C-10M	
Heated to 63°C in an incubator, held at 63°C for 10 minutes†	Heating via TADD‡ to a temperature of 63°C, held at 63°C for 10 minutes§
54C-10M	
Heated to 54°C in an incubator, held at 54°C for 10 minutes†	Heating via TADD‡ to a temperature of 54°C, held at 54°C for 10 minutes§
38C-12H	
Heated to 38°C in an incubator, held at 38°C for 12 hours†	Heating to 38°C for 12 hours§¶
20C-24H	
Left at 20°C for 24 hours†	Unused for 24 hours between loads of hogs, but not heated§¶
20C-7D	
Left at 20°C for 7 days†	Unused for 1 week between loads of hogs, but not heated§¶

* Study described in Figure 1.

† PEDV-positive feces (the challenge material) placed on an aluminum tray was subjected to a specified heat treatment and re-collection of feces, which were used to inoculate pigs by gavage to assess PEDV status (bioassay).

‡ Consistent with TADD protocols in some systems[14,15]

§ Simulates pigs exposed to a PEDV-contaminated hog trailer that had undergone decontamination via the specified procedure.

¶ Temperature lower than commonly used in TADD protocols.

PEDV = porcine epidemic diarrhea virus; TADD = thermo-assisted drying and decontamination.

the coolers were monitored with a HOBO temperature data logger (Onset Computer Corporation, Bourne, Massachusetts).

Bioassay challenge

At the expiration of the assigned time, all trays were removed from the incubator or coolers, and 10 mL of sterile 0.9% sodium chloride saline (Hospira Inc, Lake Forest, Illinois) was applied to each tray to suspend the feces for ease of re-collection. Feces were sampled again to assess the presence of PEDV by PCR. The liquid slurry of feces and saline was drawn up in a 20-mL syringe that was capped and labeled with the identification number of the single pig that was to receive the mixture. Gloves were worn and changed between trays during collection to prevent cross-contamination.

Once all trays within a group had been collected, the material was taken into the respective animal rooms for inoculation of the pigs. Personnel performing the inoculation wore disposable Tyvek coveralls (DuPont, Wilmington, Delaware) and an N95 respirator (3M, St Paul, Minnesota) that were changed between groups. Additionally, personnel wore arm-length disposable obstetrical sleeves (Agri-Pro Enterprises, Iowa Falls, Iowa) and nitrile gloves (VetOne; MWI Veterinary Supply Co, Boise, Idaho) that were changed between pigs to prevent cross-contamination. After each pig had been inoculated and the obstetrical sleeves and gloves had been discarded, the Tyvek coveralls were examined for contamination. Contaminated coveralls were removed and discarded, and a new pair was donned. Inoculation was performed via gastric gavage with an 18 French rubber catheter (Kendall; Covidien). Each pig's mouth was held open using a ¾-inch, 45° PVC elbow pipe fitting placed over the restrainer's thumb as a speculum. The catheter was then extended through the esophagus to the pig's stomach for inoculation. After administration of the challenge material and before removal of the catheter, approximately 10 mL of air was injected to clear the catheter of residual material.

After inoculation, rectal temperatures of the pigs were assessed daily using a digital rectal thermometer dedicated to each pig (VetOne; MWI Veterinary Supply Co). Diarrhea and other clinical signs were also assessed daily. On days 3 and 7 post challenge, a rectal swab was collected from each pig and tested for PEDV by RT-PCR. Tyvek coveralls, masks, gloves, and obstetrical sleeves were used when sampling pigs, employing the same procedures as when pigs were inoculated with challenge material. Pigs were not removed from their individual pens during sampling to avoid cross-contamination between individuals. Swabs from each sampling time point were immediately frozen at -80°C and submitted simultaneously to the ISU VDL to test for PEDV by N-gene-based real-time RT-PCR as previously described.[8,12]

After collection of rectal swabs on day 7 post challenge, all animals were euthanized and necropsied. Gross evaluation of all organ systems was performed and gross pathology noted. From each pig, fresh cecal and spiral colon contents, sections of fresh and 10% formalin-fixed ileum, and fresh and formalin-fixed mesenteric lymph nodes were collected. Fresh samples were immediately frozen at -80°C, and all samples were retained in the event further testing might be required to confirm the results obtained by PCR on rectal swabs.

Bioassays were considered positive if rectal swabs were PEDV-positive by RT-PCR on days 3 and 7. A Ct value of ≤ 35 was considered positive. If only one RT-PCR result was positive and the other suspect (Ct > 35

Figure 2: Study described in Figure 1. Aluminum trays used to replicate trailer construction materials measured 15.24 ×15.24 cm, with 2.54-cm high sides and a material thickness of 0.32 cm. Feces was applied to the tray (bottom left; 5 mL) and then spread in a thin layer (bottom right).

Table 2: Summary of results of testing pre- and post-treatment tray swabs by RT-PCR assay for PEDV*

Treatment group†	RT-PCR mean Ct (± SD)	
	Pre-treatment	Post treatment
Neg	> 40	NA†
Pos	15.22 (0.73)	NA†
71C-10M	13.40 (0.30)	24.10 (0.76)
63C-10M	13.16 (0.48)	21.56 (0.71)
54C-10M	13.41 (0.32)	20.83 (0.53)
38C-12H	13.28 (1.21)	20.19 (0.09)
20C-24H	14.45 (0.57)	15.07 (0.18)
20C-7D	12.94 (0.55)	17.71 (0.41)

* Study described in Figure 1. Treatment groups and the conditions they simulate described in Table 1. Mean Ct values are summarized for swabs of trays after addition of feces, before and after exposure to temperature or time of exposure.

† As Neg and Pos groups were not exposed to temperature or time treatments, no post-treatment swabs were collected for these groups.

RT-PCR = reverse-transcriptase polymerase chain reaction; PEDV = porcine epidemic diarrhea virus; Ct = cycle threshold; NA = not applicable.

and ≤ 40) or negative, or if the pig died after day 3, formalin-fixed ileum from these individuals was submitted to the ISU VDL to test for PEDV by immunohistochemical (IHC) staining and microscopic examination. In these instances, IHC results and the presence or absence of histological lesions consistent with PEDV were used to classify the bioassay result as positive or negative.

Statistical analysis (SAS Enterprise Guide 5.1; SAS Institute, Cary, North Carolina) was performed using Fisher's exact test to evaluate differences in proportions of positive bioassays between groups with small sample sizes.

Results

All trays (28 of 28) that were covered with PEDV-positive feces (Pos, 71C-10M, 63C-10M, 54C-10M, 38C-12H, 20C-24H, 20C-7D) were PEDV-positive by RT-PCR before and after exposure to the designated combinations of time and temperature. All trays covered with PEDV-negative feces (four of four; Neg) were PEDV-negative by RT-PCR. Mean RT-PCR values of trays pre-treatment and post treatment are summarized in Table 2.

All replicates that were positive by bioassay across all groups (nine of nine) were positive by day 3, and eight remained positive through day 7. The other pig died prior to day 7.

Bioassays were PEDV-negative in 100% of the pigs (four of four) in the Neg group and in groups 71C-10M and 20C-7D. Bioassays were PEDV-positive in 25% of the pigs (one of four) in groups 63C-10M, 54C-10M, and 20C-10M. Bioassays were PEDV-positive in 50% of the pigs (two of four) in group 38C-12H and in 100% of the pigs (four of four) in the Pos group (Table 3).

A 2 × 8 Fisher's exact test of all groups simultaneously, to evaluate the overall effect of treatment on bioassay outcome, found that treatment did have a significant effect on bioassay status ($P < .05$). More specifically, bioassay outcomes for groups 71C-10M and 20C-7D were significantly different from the Pos group ($P < .05$). No other groups were significantly different from one another (Table 3).

Two animals were removed from the trial early due to illness and death unrelated to infection with PEDV. In both, removal occurred after the day-3 rectal swabs were collected, but prior to day 7. Both pigs were submitted to the ISU VDL for full necropsy and diagnostic workups to determine cause of death and PEDV status. One pig in the

Table 3: Summary of swine bioassay PEDV results by treatment group*

Treatment group†	Mean RT-PCR Ct values‡		PEDV-positive bioassays (%)
	Day 3 post challenge	Day 7 post challenge	
Neg	All > 40	All > 40	0/4[a] (0)
Pos	14.3, 11.4, 10.5, 15.4	18.2, 24.6, 24.4§	4/4[b] (100)
71C-10M	> 40, > 40, > 40, 35.4	All > 40§	0/4[a] (0)
63C-10M	35.7, > 40, 36.2, 13.4	> 40, > 40, > 40, 16.3	1/4[ab] (25)
54C-10M	> 40, > 40, > 40, 18.8	> 40, > 40, > 40, 18.8	1/4[ab] (25)
38C-12H	> 40, > 40, 26.3, 14.1	> 40, > 40, 15.6, 18.1	2/4[ab] (50)
20C-24H	> 40, > 40, > 40, 11.5	> 40, > 40, > 40, 17.1	1/4[ab] (25)
20C-7D	All > 40	All > 40	0/4[a] (0)

* Study described in Figure1. Treatment groups described in Table 1.

† At the time of challenge, n = 4 for all treatment groups.

‡ Ct values ≤ 35 were considered positive; >35 and ≤ 40, suspect; and > 40, negative. Day 3 and 7 swabs were used to determine bioassay status. Bioassays with inconclusive Ct values were confirmed via histopathological examination of ileum sections in conjunction with PEDV immunohistochemistry.

§ One pig in this group died prior to the end of the trial.

[ab] Values within a column with different superscripts are significantly different ($P < .05$; Fisher's exact test).

PEDV = porcine epidemic diarrhea virus; RT-PCR = reverse transcriptase-polymerase chain reaction; Ct = cycle threshold.

positive control group (Pos) was PEDV-positive on day 3 by RT-PCR on feces and was PEDV-positive by RT-PCR on feces and IHC at removal from the study. The other pig in the 71C-10M group was PEDV-negative on day 3 by RT-PCR on feces and PEDV-negative by RT-PCR on feces and IHC at removal from the study. For the pigs not removed early, across all groups, all that were positive by bioassay on day 3 remained positive on day 7 (eight of eight), and all of the pigs that were negative by bioassay on day 3 remained negative on day 7 (22 of 22), Therefore, the bioassay outcomes, as reported in Table 3, for the two pigs removed early were considered to be sufficiently supported and were included in statistical analysis for between-group comparisons.

Discussion

The results of this study suggest that it is possible to inactivate PEDV in the presence of feces by heating trailers to 71°C for 10 minutes or by maintaining surfaces at room temperature (20°C) for at least 7 days. No other combinations of time and temperature evaluated in this study were 100% effective at inactivating PEDV.

The presence of only a single infected pig in three of the treatment groups suggests that the housing system was effective at preventing lateral transmission between pigs. This demonstrates the value of this housing model and associated biosecurity practices for further PEDV swine bioassay research.

Currently it is estimated that there are not enough livestock trailers or washing facilities in the United States to accommodate washing all livestock trailers between loads of swine (Tom Burkgren, DVM, e-mail communication, May 8, 2014). Additionally, there is a regional shortage of transporters (Jason Hocker, DVM, MS, e-mail communication, May 5, 2014), so it is difficult to shift a transporter's time from transporting swine to washing trailers while still maintaining overall hauling capacity. Washing, disinfecting, and drying times will vary among trailers, facilities, and individual protocols, but a thorough job will require a significant amount of time. A good estimate is that washing and disinfecting will require 2 hours, and drying with the use of TADD will require an additional hour, for a total time investment of 3 hours (Josh Ellingson, DVM, MS, oral communication, April 29, 2014).

For farms, systems, or trucking companies that are unable to wash, disinfect, and dry trailers due to the constraints, removing the feces and bedding by scraping and subsequently heating may be practicable. The investigators do not propose that this is a preferred alternative to thoroughly washing, disinfecting, and drying trailers. Rather, this work demonstrates the value of possible alternatives, when washing, disinfection, and drying cannot be accomplished, to reduce the risk of transmitting PEDV between groups of animals. It is important to emphasize that all time measurements in this study began when the samples achieved the target temperature via direct measurement. Variations in contamination level will likely impact the amount of time it takes to achieve the target temperature.

This information may be used to prioritize significant investments in trailer decontamination facilities. If both wash and TADD facilities cannot be built simultaneously, stakeholders will have to decide which is more important. Knowing that heating trailers to 71°C for 10 minutes will inactivate PEDV in the presence of feces may suggest that priority should be given to building TADD facilities.

When washing and disinfection do occur, it is possible that small amounts of organic material may be left behind on the trailer.[15] The activity of many disinfectants is decreased in the presence of organic material.[16,17] Additionally, the physical presence of organic material may prevent disinfectant from reaching all surfaces.[17] In these instances, it is possible that infectious PEDV remains following washing and disinfection. The presence of this potentially infectious material represents a significant biosecurity risk. Inclusion of TADD into trailer decontamination protocols will help to mitigate this risk.

The complexity of trailer design may also prevent disinfectants from reaching all surfaces and all fecal contamination. Livestock trailers are not smooth-side inside, but possess many channels, corners, hinges, and latches, all of which are capable of shielding organic matter from disinfectants. Because heat is transferred directly through metal, TADD would help mitigate this issue. However, this shielding effect of trailer design likely impacts TADD effectiveness to some degree as well. The experimental trays used in this study do not replicate this complexity and so may underestimate the risk of infection in a real-life setting.

This study used experimental group sizes of four pigs per treatment group for economic as well as facility and labor considerations. If a livestock trailer were contaminated with a small amount of infectious organic material, there is potential that many more than four

animals could interact with the material and potentially become infected. For this reason, this study may underestimate the true risk of infection associated with each treatment group.

It is noteworthy that all 24 of the experimental trays that were contaminated with PEDV-positive feces and were exposed to combinations of time and temperature (71C-10M, 63C-10M, 54C-10M, 38C-12H, 20C-24H, 20C-7D) remained positive by RT-PCR following treatment. However, the bioassay results demonstrated that only five of the 24 trays (20.8%) contained an infectious dose of live virus, and 19 (79.2%) did not. This divergence is likely due to differences in virucidal mechanisms that result in viral destruction via membrane disruption, protein denaturation, or deterioration of genetic material.[18] Following exposure to combinations of time and temperature evaluated in this study, a sufficient amount of genetic material remained intact to interact with the primers in a RT-PCR assay. This suggests that viral inactivation occurred via membrane disruption or protein denaturation. In fact, denaturing of viral proteins can occur at higher temperatures such as those described in this study.[18] Additionally, membrane disruption can occur through desiccation of the virus, and it was noted that feces did dry during the heating process. This illustrates that RT-PCR-positive environmental samples of trailers do not necessarily indicate infectious virus is present.

A wide range of temperatures was evaluated in this study to identify effective temperatures at the high end, and ineffective temperatures at the lower end of the range. While this was a good strategy for an initial study, it resulted in a range of temperatures each separated by 7°C or more. Many current TADD facilities operate between 63°C and 71°C.[14] Additionally, at these higher temperatures, significant fuel costs and equipment wear accompany each incremental increase in temperature. Further study evaluating a higher resolution of temperature and time in this range is needed to optimize TADD protocols for inactivating PEDV.

Implications

- Under the conditions of this study, heating scraped, unwashed aluminum trays to 71°C for 10 minutes or allowing them to sit for 7 days at room temperature may be sufficient to prevent transmission of PEDV present in feces as determined by bioassay.
- Under the conditions of this study, exposure to 63°C and 54°C for 10 minutes, 38°C for 12 hours, or room temperature for 24 hours, are not 100% effective at inactivating PEDV in feces.
- Appropriate TADD protocols may be effective at inactivating PEDV in trailers where fecal matter and bedding have been removed by scraping or when some organic matter is present following power washing and disinfection.

Acknowledgements

Funding was provided by The National Pork Board. The authors would also like to thank AMVC Management Services for in-kind support and students and staff of the Swine Medicine Education Center at Iowa State for assistance with live-animal work.

Conflict of interest

None reported.

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Peer reviewed

Original research

Characterization of histopathologic lesions among pigs with overgrown claws

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Summary

Objective: To characterize histologic lesions in pigs with and without claw overgrowth.

Materials and methods: Hindlimb claws from a subset of 24 sows that were part of a larger field study were selected because of claw deformities associated with overgrowth and change in gait. Length measurements were available for 72 lateral or medial rear claws. Claws were examined histologically and the lesions categorized. Overgrowth was defined as a toe growth measuring > 50 mm in length.

Results: Lateral rear claws were most consistently overgrown. However, the distribution and severity of lesions failed to suggest a common etiology for overgrowth. Inflammation, arteriosclerosis, lamellar epithelial changes, phalanx rotation, or combinations of these were not prominent gross or histologic changes.

Implications: The pathogenesis of overgrowth in this collection of claws is unknown, but does not appear to represent primary laminitis in this species. As lameness continues to prompt a significant economic loss due to culling, further studies on claw overgrowth, its effect on motion, and its pathogenesis are warranted.

Keywords: swine, claw, corium, hoof, laminitis

Received: March 24, 2014
Accepted: September 16, 2014

Resumen - Caracterización de lesiones histopatológicas entre cerdos con pezuñas crecidas

Objetivo: Caracterizar las lesiones histológicas en cerdos con y sin pezuñas aumentadas de tamaño.

Materiales y métodos: Se seleccionaron pezuñas de patas traseras de un subgrupo de 24 hembras que formaban parte de un estudio de campo más grande, debido a las deformidades de las pezuñas relacionadas con aumento de crecimiento y paso alterado. Las medidas de longitud estuvieron disponibles para 72 pezuñas traseras medias o laterales. Se examinaron las pezuñas histológicamente y se categorizaron las lesiones. El aumento en el crecimiento se definió como el crecimiento del dedo con una medida > 50 mm de longitud.

Resultados: Las pezuñas traseras laterales fueron consistentemente más grandes. Sin embargo, la distribución y la severidad de las lesiones no sugieren una etiología común de aumento en el crecimiento. La inflamación, la arteriosclerosis, los cambios epiteliales laminares, la rotación de falange, o las combinaciones de estos no fueron cambios prominentes macro ni histológicos.

Implicaciones: La patogénesis del aumento de tamaño en esta serie de pezuñas es desconocida, pero no parece representar laminitis primaria en esta especie. Debido que la cojera continua provocando una pérdida económica significante debido al desecho, es necesario hacer más estudios sobre el aumento de tamaño de las pezuñas, sus efectos en el movimiento, y su patogénesis.

Résumé - Caractérisation des lésions histopathologiques chez des porcs avec des onglons à croissance exagérée

Objectif: Caractériser les lésions histologiques chez des porcs avec et sans onglons à croissance exagérée.

Matériels et méthodes: Les onglons des pattes arrière d'un sous-groupe de 24 truies faisant partie d'un plus grand groupe d'étude furent sélectionnés à cause des difformités associées à la croissance exagérée des onglons et de changement dans la posture. Des mesures de la longueur de 72 onglons latéraux et médiaux étaient disponibles. Un examen histologique des lésions fut effectué et les lésions caractérisées. Une croissance exagérée était définie comme étant la croissance d'un orteil mesurant > 50 mm en longueur.

Résultats: Les onglons latéraux arrière étaient ceux présentant le plus souvent une croissance exagérée. Toutefois, la distribution et la sévérité des lésions n'ont pas permis de trouver une étiologie commune pour cette croissance exagérée. L'inflammation, l'artériosclérose, des changements épithéliaux lamellaires, la rotation de phalange, ou toutes les combinaisons de ces changements n'étaient pas des changements macroscopiques ou histologiques évidents.

Implications: La pathogénie de la croissance exagérée dans la présente collection d'onglons est inconnue, mais ne semble pas représenter une laminite primaire chez cette espèce. Étant donné que les maux de pattes continuent de représenter des pertes économiques significatives à cause de la réforme des animaux, des études supplémentaires sur la croissance exagérée des onglons, ses effets sur la mobilité, et sa pathogénie sont justifiées.

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

Newman SJ, Rohrbach BW, Wilson ME, et al. Characterization of histopathologic lesions among pigs with overgrown claws. *J Swine Health Prod.* 2015;23(2):91–96.

Lameness resulting from overgrown claws in large commercial swine operations in the United States and other countries has become an important economic and welfare issue.[1] Routine claw trimming can provide some relief, but is labor intensive. Early culling is another detrimental outcome. Causes of claw overgrowth may be multiple and the result of an extended duration from point of insult until pathologic assessment. Causes include toxic,[2] parturition-associated,[2,3] or nutritional etiologies,[2] and may be affected by management, housing, body weight, weight distribution on individual claws, trauma, or combinations of these.[2,4]

In cattle with inflammatory disease of the corium, defined as laminitis, claws are often overgrown and contain horizontal and vertical wall grooves, cracks, and white-line separations.[5] These gross changes are also observed in swine, but an association with a primary inflammatory condition is less clearly determined in pigs due to the few descriptive histologic studies reported in the peer-reviewed literature for swine.[2-4] A recent publication from Brazil characterized laminitis in pigs by radiographic evaluation, and distal phalanx rotation was confirmed in one or multiple digits.[4] Additionally, the lateral claw was consistently longer than the medial claw.[4] In another study, claws of 11 pigs with chronic lameness were histologically assessed.[2] Five had sclerosis and dyskeratosis, which those authors associated with faulty horn formation and lameness. In a series of acute lameness cases from 24 post-parturient pigs, histological examination showed hyperemia, hemorrhage, thrombosis, swelling and disorganization of epithelial cells of the stratum germinativum layer, and, rarely, retraction of the keratin layer from the most basal four or five layers of epithelium, resulting in a cleft.[3] Causes of swine claw lesions were often undetermined, but considerations included toxicosis[2] and parturition-related[2,3] or nutritional reasons.[2]

Continued studies of claw lesions are necessary to characterize claw overgrowth in pigs and determine contributing causes for development of claw overgrowth. The objectives of this study were to evaluate the available rear claws from 24 sows and assess histologic lesions in hopes of discovering more about the pathologic changes associated with overgrown claws, and to compare the lesions to those seen in laminitis.

Materials and methods

The specimens for this study were obtained from a larger study that was conducted in accordance with the Institutional Animal Care and Use Committee (IACUC) guidelines.

A group of 24 commercial Landrace-Large White F-1 crossbred sows, ranging from third to seventh parity (median, fourth parity) were housed at a large facility and selected for this study because of gross overgrowth of one or both hind claws in the absence of significant lameness. In these sows, the caregivers noticed a change in locomotion that they attributed to the necessity for these sows to lift their limbs differently, but none were assigned lameness scores prior to slaughter. The examined claws were selected from a representative cohort of sows from a larger group with varying degrees of claw overgrowth. The total number of sows was based on convenience and included the number that could be transported to slaughter simultaneously.

Sows were fed a corn-soybean-based gestation and lactation ration or a diet supplemented with Availa Zn (50 mg zinc-amino acid complex per kg feed), Mn (20 mg manganese-amino acid complex per kg feed), and Cu (10 mg copper-amino acid complex per kg feed) (Zinpro Performance Minerals, Eden Prairie, Minnesota) for partial replacement of inorganic trace minerals.

All pigs were housed in swine barns designed with heating and cooling from a forced-air system. Sows were housed on fully slatted concrete floors during breeding and gestation periods, and in farrowing stalls with cast-iron slatted flooring during periparturient and lactation periods. Wells providing water for the farm site were charged with chlorine monthly. During gestation, water was delivered via trough waterers filled twice daily. Water in farrowing crates was from nipple waterers. Parasite control programs were not used in these sows.

The two rear feet collected at slaughter from each of 24 sows were evaluated at the University of Tennessee, Department of Biomedical and Diagnostic Sciences, Anatomic Pathology Division (Knoxville, Tennessee). Rear claws were chosen for assessment because of their propensity to be overgrown.[4,6-9] Photographs of a range of normal, overgrown, and deformed claws were taken by the pathologist to categorize the lesions prior to histologic sample collection (overgrown claws shown in Figure 1). Control rear claws collected from six sows with visibly normal rear feet at slaughter were used for comparisons. Claws were sectioned sagittally with a band saw to obtain thin slices for formalin fixation. Two authors (SJN, SVA) assessed the slices for phalanx rotation. In some instances, feet were further sectioned into numerous smaller pieces to facilitate easier formalin storage prior to measurement. Hence, only claws with complete measurements of length from the coronary band to the tip of the toe were included in the study (total 72 of 96 claws).

Measurements for each claw were determined and recorded. Determination of what defined overgrowth (claw lengths > 50 mm) was extrapolated from work on claw-length measurements in gilts published by one of the authors (SVA).[10] Claws were then divided into representative, full-thickness, 2- to 5-mm sagittal sections, and the samples were fixed in 10% buffered formalin. Representative sections of each claw were obtained by using a razor blade to remove the soft tissue between the bone of the third phalanx and the hoof wall. The samples were subsequently oriented within the tissue-processing cassette so that laminae were cut in longitudinal sections to allow for best viewing. In those instances where very small regions of lamellar or coronary corium were present, tissue sections were re-oriented by melting the paraffin blocks, then placing the tissues at a 90° angle to the original orientation in order to maximize the information obtained from each sample. Tissue samples were routinely processed, embedded in paraffin, sectioned at 3 μm, and stained with hematoxylin and eosin (HE).[11] A single board-certified pathologist (SJN) reviewed the slides in a blinded manner. Histopathological findings for each claw were recorded as present or absent. Pathologic lesions were evaluated for the following categories: lymphoplasmacytic inflammation, neutrophilic inflammation, eosinophilic inflammation, or overall inflammation (if a combination of types were present); and epithelial apoptosis, epithelial necrosis, epithelial vacuolation, or overall epithelial changes (if a combination of types were present). Additionally, an assessment for arteriosclerosis of chronic laminitis was conducted using HE-stained sections.

Statistical analysis

A chi-square test was used when an expected cell value in the 2 × 2 table was < 5, but when an expected cell value was ≥ 5, the more statistically appropriate test, the Fisher's exact test, was used to evaluate the association between overgrowth and histopathological findings. All analyses were performed with a commercial software program (SAS version 9.2; SAS Institute, Cary, North Carolina); *P* values < .05 were considered significant in all tests.

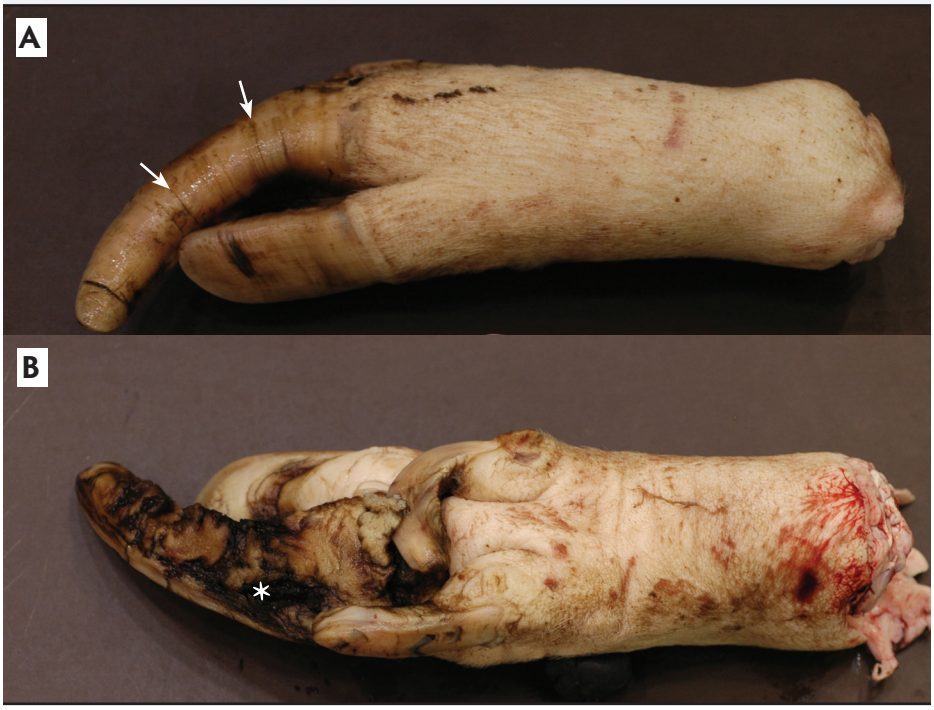
Results

Grossly, 39 claws (54%) were considered overgrown, and 33 claws (46%) were normal length. The range of lengths for the overgrown claws was 51 to 79 mm (median, 59.5 mm), and the range of lengths for normal claws was 38 to 50 mm (median, 45.0 mm). Lateral claws were more commonly overgrown (26 of 39; 67%) than medial claws (13 of 33; 39%). Examples of overgrown claws are shown in Figure 1. Two authors (SJN, SVA) examined all sagittal sections of claws and did not identify distal phalanx rotation in any of them. Because phalanx rotation was not identified in any of the samples, statistical assessment was not performed.

Coronary corium was available from the majority of the samples (66 of 72; 92%), and lamellar corium was available from 17 of 72 (24%). All claws had at least one corium, either lamellar or coronary, available for assessment, and 14 of 72 (19%) had both. Examples of representative overgrown and normal length claws and the distribution of histologic lesions (Figure 2) are presented along with *P* values for comparisons in Table 1.

Overgrown claws were not significantly associated with any individual inflammatory cell infiltrate nor a combination of inflammatory cell types (inflammation). Additionally, overgrown claws were not significantly more associated with changes in the epithelium of the corium or lamellar laminae or a combination of epithelial changes (epithelium). Vascular changes (arteriosclerosis) were assessed in a subset of traditionally processed claws and were not identified; hence, statistical assessments were not performed.

Figure 1: Right hind hoof of a sow with severely overgrown claws. Both dorsal (A) and ventral (B) claw surfaces are shown. Note horizontal grooves (A; arrows) and accompanying ulcerative lesions ventrally (B; asterisk).



Discussion

Determining causes and significance of overgrown claws in pigs is an ongoing area of research because of its perceived impact on foot health and lameness. Lameness resulting from overgrown claws in large commercial swine operations in the United States and other countries has become an important economic and welfare issue and can be detrimental because it results in increased and early cull rates. Routine claw trimming can provide some relief, but is labor-intensive. van Amstel et al[10] determined that 39 mm was the length after which the claws were considered overgrown for gilts. On the basis of one author's (SVA's) experience trimming claws in adult sows, a length of 50 mm is recommended, as trimming shorter than that resulted in bleeding from the quick corium in some cases. Hence, for the purpose of this study, overgrown claws were identified as those measuring ≥ 50 mm and totaled 39 of the 72 claws (54%) available for examination.

Of the total of overgrown claws in this study, 67% were lateral rear claws. Lateral rear claw prevalence for lesions and overgrowth has been reported previously.[4,6-9] The lateral claw is often more overgrown than the medial due to normal weight-bearing stress in sows in commercial operations,[9] although it has also been reported that the medial hind claws are more overgrown than the lateral hind claws when the pig has laminitis.[4] Unequal weight distribution between claws causes the rate of horn growth to exceed the rate of wear, and the imbalance in this weight distribution results in different lengths of claws, with the lateral claws being more severely affected.[4] This disparity of claw size was also noted by authors of another study[10]where claw sizes were measured over a period of 55 days; the average size of the lateral rear claws was 1266 mm^2, whereas that of the medial rear claws was 959 mm^2. Once size disparity exists, it can produce abnormal conformation or postural and stride abnormalities that may cause ongoing lameness.[10]

The lack of definitive gross lesions (distal phalanx rotation) or histologic lesions, ie, inflammation, arteriosclerosis, or epithelial changes within the laminae, suggests that overgrown claws in this group of pigs are likely due to a variety of other factors, including management, flooring, uneven weight bearing, or diet. Overgrown claws in weaned pigs have been associated with damaged, slippery, or rough floor surfaces, suggesting that, for weaned pigs, the quality of the flooring may be the most important aspect of housing.[2] The use of mats as a floor covering has also been associated with overgrown claws, but the

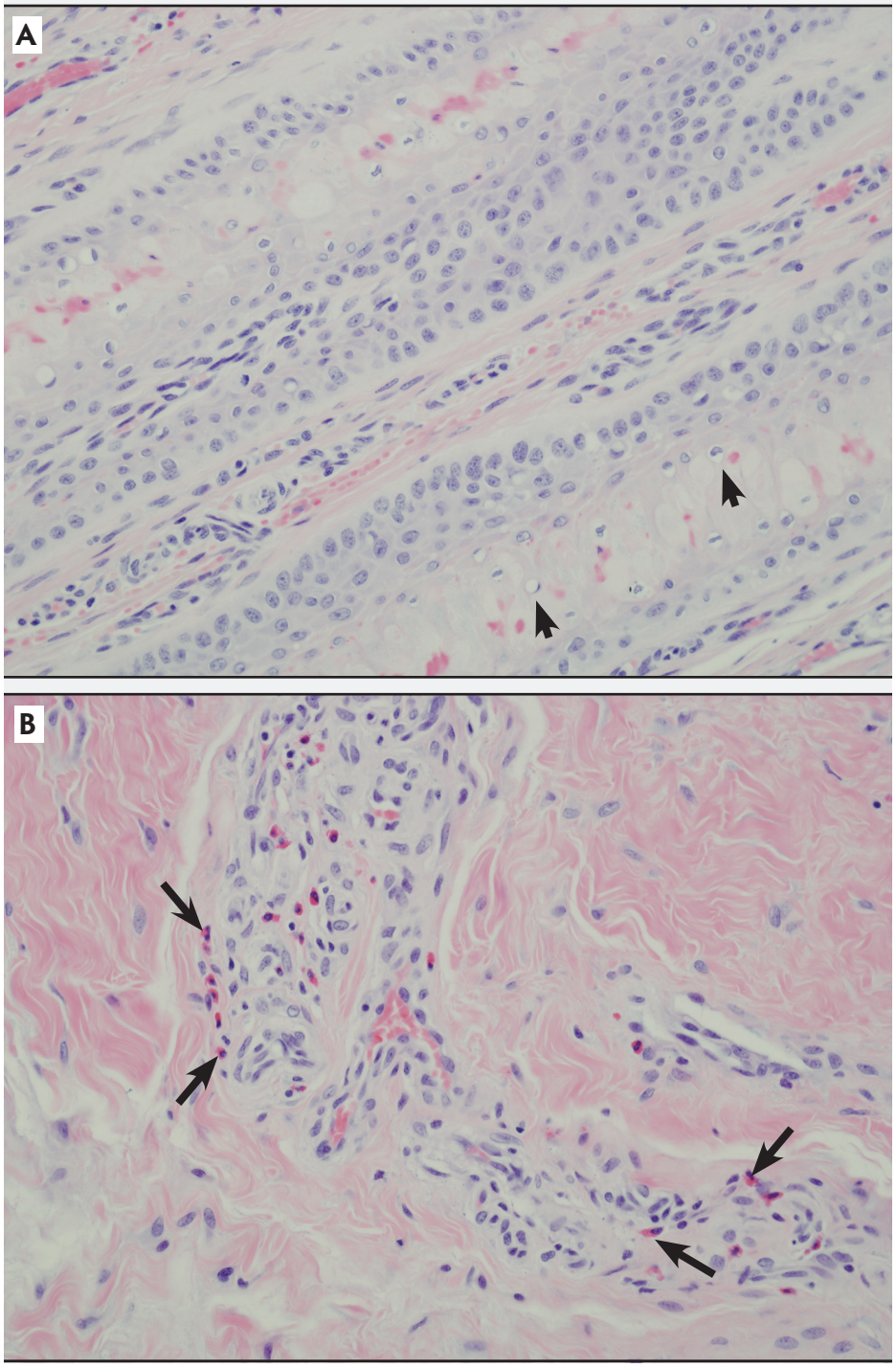
documented overgrowth did not correlate to clinical lameness in that study.[12] That result is similar to the absence of lameness despite significant overgrowth in many of the animals in this study. Nonetheless, ambulation may be altered by such overgrowth, and the need for corrective trimming may be warranted.

Pigs in this study were mature sows that had been housed at the same facility for one or more parities. During the breeding and gestation periods, all sows were housed on fully slatted concrete floors, and during the periparturient and lactation periods, they were housed in farrowing stalls with cast-iron slatted flooring. Hence, it is difficult to determine how much effect, if any, housing environment had on any recognized lesions, as all pigs were handled similarly.

While claw overgrowth can be seen in instances of laminitis,[4] the phalanx rotation typically associated with laminitis was not identified, nor were histologic lesions involving vessels, as might be expected in more chronic cases. Histologic assessment of inflammation of the laminae (laminitis) and laminar epithelial changes were not consistently seen in the overgrown claws examined in this case series.

One of the goals of the study was to determine the incidence of histologic lesions, both in the epithelium of the laminae and the dermis of the claw, from a range of rear claws, many of which were overgrown. Main categories of assessment included epithelial changes, such as vacuolation, apoptosis, and necrosis; and infiltration of a variety of inflammatory cells, including lymphocytes, plasma cells, eosinophils, and neutrophils. In some samples, while inflammation was present, it was often non-specific and mild. Overall inflammation and inflammation subtypes were seen more in overgrown claws (14) than in normal claws (12), but the total numbers were insufficient to obtain statistical significance. The range of inflammatory infiltrates was narrow and did not allow a grading scale based on severity to be determined. The infiltrates varied in type, but there was no consistent inflammatory cell predominance. The presence of eosinophils is often associated with allergy-hypersensitivity or parasitism in most species, but the pig has a propensity to respond with eosinophils non-specifically within tissues.[13] Typically, neutrophils are seen in acute active inflammation. The presence of lymphocytes and plasma cells often indicates more chronic, nonspecific processes.

Figure 2: Histologic sections of the hooves of sows with overgrown claws. A: Within the lamellar epithelium are apoptotic cells, cellular vacuolation (arrowheads), and excessive accumulations of keratin (×20). B: Moderate numbers of perivascular eosinophils (arrows) are present (×40). C: Inflammatory response (asterisks) in the epithelium and subepithelium (×4). All sections stained with hematoxylin and eosin.



Epithelial changes indicative of acute or ongoing damage were not a prominent finding among study pigs. Epithelial changes were seen more in overgrown claws (nine) than in normal claws (three), but again, the total numbers were too small for comparison, and statistical significance could not be achieved. When present, epithelial changes demonstrated some histologic characteristics similar to those reported in acute laminitis in other species, but were mild and rarely included all characteristics. Porcine claw lesions did not appear to have a common pathogenesis or

Figure 2: Continued

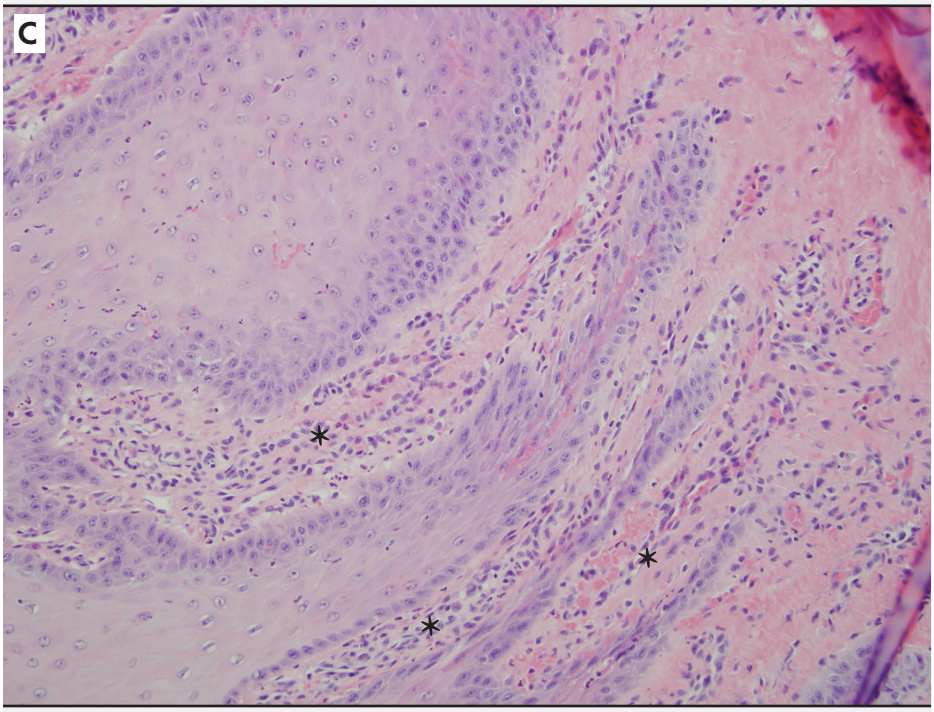


Table 1: Comparison of histological characteristics among a sample of normal (n = 33) and overgrown (n = 39) porcine claws*

	No. overgrown (%)		*P*†
Lesion	**Yes**	**No**	
Apoptosis	4 (10)	0 (0)	.12
Eosinophilic inflammation	8 (21)	5 (15)	.56
Epithelial necrosis	2 (5)	0 (0)	.50
Lymphoplasmacytic inflammation	8 (21)	9 (27)	.50
Neutrophilic inflammation	6 (15)	4 (12)	.75
Vacuolation	6 (15)	3 (9)	.49
Combined epithelial parameters	9 (23)	3 (9)	.12
Combined inflammatory parameters	14 (36)	12 (36)	.97

* Pathologic lesions were evaluated for the following categories: lymphoplasmacytic inflammation, neutrophilic inflammation, eosinophilic inflammation, or overall inflammation (if a combination of types were present); and epithelial apoptosis, epithelial necrosis, epithelial vacuolation, or overall epithelial changes (if a combination of types were present).

† A chi-square test was used when an expected cell value in the 2 × 2 table was < 5; Fisher's exact test was used when an expected cell value was ≥ 5. For all comparisons, $P < .05$ was considered significant.

histologic lesion, and inflammation and epithelial changes were infrequent overall. In chronic cases, it is difficult to know whether the changes seen are cause or effect.

This study was intended to generate hypotheses rather than test a specific hypothesis, and while this represents a preliminary study, small sample size may have prevented clear associations. It would be important to examine a larger number of overgrown and normal claws and assess the incidence and severity of histologic lesions in an effort to clarify the common etiology for porcine claw overgrowth. Studies for claw lesions that include larger numbers of pigs from different sources representing a variety of housing conditions and feeding management are necessary to characterize the histologic lesions associated with overgrowth, determine the role of laminitis, and determine contributing causes of overgrowth development, including the effect of diet.

Implications

- Claw overgrowth may not be associated with significant inflammation or epithelial changes in the laminae.
- Additional studies are warranted to determine whether histologic changes similar to laminitis are seen in overgrown claws.
- Additional studies are warranted to determine underlying causes of overgrown claws.

Acknowledgements

Special thanks to Sharon Schlosshan for technical assistance and Misty Bailey for editorial assistance.

Conflict of interest

None reported.

Disclaimer

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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, lb to kg (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

Peer reviewed

Brief communication

Effect of short (10- or 12-day) or standard (14- or 18-day) periods of estrus suppression with allyl trenbolone on estrus synchronization and fertility in pubertal gilts

F. De Rensis, DVM, PhD; C. Mazzoni, DVM; R. Saleri, DVM, PhD; M. Techakumphu, DVM, PhD; R. N. Kirkwood, DVM, PhD, Diplomate ECAR

Summary

Allyl trenbolone was fed at 20 mg per day for 10, 12, 14, or 18 days, with two 75-µg injections of D-cloprostenol at last feeding at 10 or 12 days to synchronize estrus in gilts. There were no treatment effects on farrowing rate or subsequent litter sizes.

Keywords: swine, allyl trenbolone, D-cloprostenol, estrus synchronization, fertility

Received: July 28, 2014
Accepted: November 12, 2014

Resumen - Efecto de los periodos corto (10 ó 12 días) o estándar (14 ó 18 días) de supresión del estro con allyl trembolona en la sincronización del estro y fertilidad en hembras púberes

Se administró allyl trembolona en el alimento a 20 mg por día por 10, 12, 14, ó 18 días, con dos inyecciones de 75 µg de D-cloprostenol en el último alimento a los 10 ó 12 días para sincronizar el estro en hembras primerizas. No hubo efecto del tratamiento en el porcentaje de fertilidad o en el tamaño de camada subsecuentes.

Résumé - Effet d'une période courte (10 ou 12 jours) ou standard (14 ou 18 jours) de suppression d'œstrus avec de l'allyle de trenbolone sur la synchronisation de l'œstrus et la fertilité chez les cochettes pubères

L'allyle de trenbolone a été administré par la nourriture à une dose de 20 mg par jour pour 10, 12, 14, ou 18 jours avec deux injections de 75 µg de D-cloprosténol au moment du dernier repas à 10 ou 12 jours afin de synchroniser l'œstrus chez les cochettes. Aucun effet de traitement ne fut noté sur les taux de misebas ou la tailles des portées subséquentes.

Gilt pools frequently house large groups of randomly cycling gilts to ensure that sufficient service-ready gilts are available to meet weekly breeding targets. The need for large numbers of gilts can be reduced if estrus synchronization is employed. Some degree of synchronization of estrus in gilts can be attained by appropriate use of the boar effect or administration of exogenous gonadotrophins, although these practices are effective only for prepubertal gilts.[1] For cyclic gilts, a relatively precise and predictable synchronization of estrus can be achieved by feeding the orally active progestogen allyl trenbolone (AT). Depending on the country, the standard treatment protocols are to feed AT at 15 or 20 mg per day for either 14 or 18 days.[2-4] After AT withdrawal, 93% of gilts were in estrus by days 5 to 7, with improved farrowing rates to insemination at this estrus.[4] Interestingly, in the mare,[5] cow,[6-8] and ewe,[9] long-term progesterone administration compromised luteinizing hormone (LH) secretion, follicular development, oocyte quality, uterine environment, and fertility, and there are recent data showing that a shorter (5-day) compared to a standard (9-day) duration of a progesterone-based treatment of dairy cows improved fertility.[10] It is not known if a similar situation can occur in gilts. However, when AT administration occurs at random stages of the estrous cycle, some animals at the beginning of treatment will be in their late luteal phase. Consequently, the duration of endogenous, followed by exogenous, progestagenic activity on ovarian activity could be more than 30 days and fertility may be compromised. In contrast, it is possible that a shorter period of AT feeding may result in improved fertility. The aim of the present study was to evaluate the effect of a shorter period of AT feeding on fertility of pubertal gilts.

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

De Rensis F, Mazzoni C, Saleri R, et al. Effect of short (10- or 12-day) or standard (14- or 18-day) periods of estrus suppression with allyl trenbolone on estrus synchronization and fertility in pubertal gilts. *J Swine Health Prod.* 2015;23(2):97–99.

Material and methods

The experiment was performed in compliance with the requirements of the University of Parma Animal Care Committee and applicable Italian and EU law. As the experiment was performed in a farm outside the university and involved no special treatment outside of normal commercial practice, the Parma Animal Care Committee was informed of the study but approval was not required.

Animals

The experiment was conducted on a commercial 650-sow farm with in-house multiplication located in Parma province, Italy, between February 2011 and January 2012. Starting at approximately 110 kg body weight and 200 days of age, gilts (PIC Camborough-22) were subject to contact with a mature boar to facilitate estrus detection. At detection of estrus, gilts were transferred to gestation stalls and were fed a commercial dry-sow ration formulated to supply 3.1 kcal per kg and 0.62% total lysine at 2.0 kg per day. Water was available ad libitum.

Experimental protocol

A total of 501 pubertal gilts between day 1 and 19 of their estrous cycles were distributed among four experimental groups involving the feeding of 20 mg per day of the orally active progestogen, altrenogest (AT) (Altresyn; CEVA, Agrate Brianza, Italy), mixed in a small amount of feed for periods of 10, 12, 14, or 18 days, and two intravulvar injections of 75 μg of the prostaglandin F2α analog, D-cloprostenol (Dalmazin; Fatro, Bologna, Italy) 6 hours apart on the day of last altrenogest feeding for the 10-day and 12-day altrenogest treatments (Table 1). The day of first feeding of AT was designated as day 0 of the study. D-cloprostenol has a potency 10-fold greater than that of the racemic DL-cloprostenol[11] and was administered to minimize the risk of residual luteal activity at the end of the shorter feeding periods.

Beginning at AT withdrawal, gilts were exposed to 10 minutes of fence-line boar contact twice daily for estrus detection and, at estrus detection and 24 hours later, gilts were inseminated with 2.6×10^9 sperm in 90 mL M-RA extender (Hermitage Italia, Castellazzo, Reggio Emilia, Italy). All semen was used by 3 days after collection. Mean and standard deviation (SD) gilt age and weight at breeding were 232 ± 3.8 days and 138 ± 8.6 kg, respectively. At their post-treatment estrus, estrus intensity was subjectively scored by one person on a scale of 1 (very weak estrus signs) to 5 (very strong estrus signs),[12] and the duration of estrus and the interval between the end of treatment and estrus were recorded. Farrowing rate was the percent of inseminated gilts that farrowed. Total and liveborn litter sizes were recorded.

Statistical analysis

Treatment effects on proportion of gilts returning to estrus and farrowing rates were examined using Fisher's exact test. Treatment effects on litter sizes were examined using the Wilcoxon-Mann-Whitney test, and effects on interval between the end of treatment and estrus were examined using Student's *t* test. For all comparisons, $P < .05$ was considered significant.

Results

Overall, the average rate of gilts in estrus after treatment was 95%, the mean interval between the end of treatment and estrus was 5.5 ± 0.8 days, the mean estrus score was 4.3 ± 0.6, and the farrowing rate was 84%, with no differences attributable to treatment (Table 2; means ± SD reported). There was no significant effect of treatment on mean numbers of piglets born or born alive ($P > .05$; Table 2).

Discussion

In this study, 93% to 96% of gilts were in estrus approximately 5 to 6 days after AT withdrawal. These results are similar to those of previously reported studies in which the administration of AT for 14 or 18 days synchronized estrus within 5 to 7 days in 84% to 96% of treated gilts.[4,13] Our working hypothesis that a different duration of progestagen treatment can influence fertility in pubertal gilts has been rejected. Indeed, in our study, estrus synchronization, farrowing rate, and piglets born after a short (10 or 12 days) or a standard (14 or 18 days) administration of AT were not different. This is in contrast to limited data from gilts where an 18-day AT feeding period yielded superior fertility results compared to a 14-day feeding period[14] or data from mares,[5] cows,[6-8] and ewes,[9] in which the duration of a progestagen treatment can influence LH secretion, follicular development, oocyte quality, uterine environment, and fertility, with the longer treatments having negative effects.[5-10] The differences between species might be related to the patterns of follicular development, follicular waves, and follicular dominance.

A practical implication of the present study is that the efficacy of a 10- or 12-day AT administration for estrus synchronization, when followed by prostaglandin-induced luteolysis, does not compromise fertility, compared to a treatment for 14 or 18 days. These data provide information that will allow producers to further fine-tune gilt availability for service and so ease the attainment of breeding targets.

Implication

A shorter period of progestagen-induced estrus suppression (10 to 12 days) followed by exogenous prostaglandin-induced luteolysis results in fertility comparable to that of gilts suppressed for 14 or 18 days.

Acknowledgements

We thank Professor Ezio Bottarelli for statistical analysis and Dr Carlo Gazza, Fatro, for providing the D-cloprostenol.

Conflict of interest

None reported

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Table 1: Treatments administered to 501 pubertal gilts between day 1 and 19 of their estrous cycles

Group (n)	Altrenogest fed* (days)	D-cloprostenol injections†
AT18 (196)	18	None
AT14 (135)	14	None
AT12 (97)	12	Day 12
AT10 (73)	10	Day 10

* Altrenogest (Altresyn; CEVA, Agrate Brianza, Milan, Italy; 20 mg/day) was mixed with a small amount of feed for 10, 12, 14, or 18 consecutive days.

† Two intravulval injections of 75 μg of the prostaglandin F2α analogue, D-cloprostenol (Dalmazin; Fatro, Bologna, Italy), were administered 6 hours apart on the day of final AT feeding.

Table 2: Performance of gilts treated with 20 mg/day allyl trenbolone (AT) for 18, 14, 12, or 10 days*

	AT18	AT14	AT12	AT10
Gilts treated	196	135	97	73
No. of gilts in estrus (%)	188 (96)	129 (95)	91 (93)	69 (94)
Estrus score†	4.3 ± 0.2	4.4 ± 0.3	4.0 ± 0.5	4.1 ± 0.7
AT to estrus (days)‡	5.2 ± 0.7	5.4 ± 1.5	5.6 ± 2.2	5.9 ± 2.7
Duration of estrus (hours)‡	54 ± 6.2	48 ± 8.1	56 ± 12.2	54 ± 11.4
No. of gilts farrowing (%)	156 (82)	104 (80)	77 (84)	60 (82)
Litter size (total)‡	13.3 ± 3.4	13.4 ± 2.5	12.8 ± 2.8	13.3 ± 2.5
Litter size (alive)‡	12.2 ± 4.2	11.5 ± 4.2	10.8 ± 3.8	12.2 ± 4.3

* Gilts treated for 10 or 12 days were administered two 75-µg intravulvar injections of D-cloprostenol at the time of last AT feeding. Treatment effects on proportion of gilts returning to estrus and farrowing rates were examined using Fisher's exact test. Treatment effects on litter sizes were examined using the Wilcoxon-Mann-Whitney test. Effects on interval between the end of treatment and estrus were examined using Student's *t* test. No significant differences ($P > .05$) between the four treatments were detected.

† Intensity of the post-treatment estrus was subjectively scored on a scale of 1 (very weak estrus signs) to 5 (very strong estrus signs).[12] Mean ± standard deviation reported.

‡ Mean ± standard deviation reported.

the rules and regulations governing research or the practice of veterinary medicine in their country or region.

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National Pork Board names Chris Hodges as chief executive officer

Chris Hodges, a pork industry leader with substantial senior management experience in agriculture, has joined the National Pork Board as its new chief executive officer. Previously based in Kansas City, Hodges was most recently senior vice president-business development of Smithfield Farmland.

"When I first joined what was then Farmland Industries as a grain division manager, I joined a farmer cooperative," said Hodges. "Over the years, I have grown to understand the needs and challenges facing pork producers from product marketing to disease management to sustainability."

Hodges brings to the Pork Checkoff decades of in-depth knowledge and innovation in marketing pork to key US food retailers and into international markets. Much of his fresh pork marketing experience includes direct producer outreach and involvement related to adopting on-farm practices specifically designed to improve overall meat quality.

"As we move forward with the implementation of our new 2020 strategic plan, we feel confident that Chris is the right person to lead the organization," said Dale Norton, president of the National Pork Board and a producer from Bronson, Michigan. "He brings not only years of professional work experience, but first-hand knowledge and insight into our changing industry. We welcome him on board."

National Pork Board Chief Executive Officer Chris Hodges

New Swine Health Information Center forming board of directors

With its goal of improving the US pork industry's preparedness for disease challenges, the new national Swine Health Information Center (SHIC) has announced several of its key board members as it gets closer to its proposed operational start date of April 1.

According to Paul Sundberg, vice president of science and technology at the National Pork Board (NPB), the nonprofit organization's board of directors who represent the National Pork Board, the National Pork Producers Council (NPPC), the American Association of Swine Veterinarians (AASV), and at-large US pork producers will welcome the following people to help them fulfill the mission of the new center.

From AASV, Dr Matt Anderson, Algona, Iowa, and Dr Daryl Olsen, Audubon, Iowa; from NPPC, Dr Howard Hill, Cambridge, Iowa, and Bill Luckey, Columbus, Nebraska; and from NPB, Dr Brett Kaysen, Nunn, Colorado, and Mark Greenwood, Carlyle, Illinois. At-large producers being filled at time of printing.

"We're very pleased that these individuals will help direct the center's strategies that will help us to implement the primary goals of the new organization," Sundberg said. "Their input and oversight will be critical to our success."

The four main objectives of the autonomous SHIC include forming a network to identify, prioritize, and update information about diseases around the world that pose various levels of risk to the US swine herd; enhancing the diagnostic capabilities needed to detect and respond to those diseases; providing the infrastructure for industry-driven and controlled data needed for analysis and communication of endemic and emerging swine health issues; and enhancing producer and veterinarian awareness of the biosecurity and biocontainment needed to address emerging disease risk.

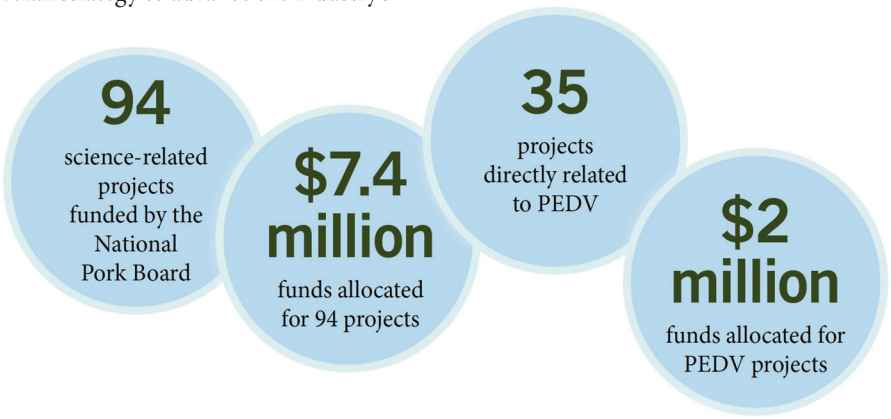
"It's our intention to establish a center that can improve our preparedness for swine diseases with the combined resources or collaboration of swine veterinarians, producers, researchers, diagnosticians, and state and federal animal-health officials," Sundberg said. "We have learned a lot over the past year and a half from our experience with porcine epidemic diarrhea virus and we want to create a unique, collaborative system that will help us achieve our overall goal of being better prepared for the next emerging swine disease."

Find answers to low farrowing rates and more

The *National Swine Reproduction Guide* is a Web-based trouble-shooting guide that is available at **usporkcenter.org/store** from the US Pork Center of Excellence. Accessed through personal computers, smartphones, and tablets, the guide offers extensive information and support to help producers solve swine reproductive problems. The cost is $75 annually for the licensing fee, with a 1-week free trial available. For more information, contact Chelsey Branderhorst at **CBranderhorst@usporkcenter.org** or call 515-223-2641.

Science and Technology Department highlights 2014 figures

Although 2014 was dominated by the challenge of battling porcine epidemic diarrhea virus (PEDV), the Pork Checkoff's science and technology team continued to work on many other critical issues as well under the guidance of its producer-led committees. The Science and Technology Department's overall strategy to advance the industry's knowledge and sustainability by creating practical on-farm solutions in all of its key areas remains firm – and will be critical to the success of the National Pork Board's new 5-year strategic plan. Some key figures from 2014 are highlighted below. If you want to find out more, go to **www.pork.org**.



PQA Plus versus the common audit

By now, you are somewhat familiar with the recently launched pork industry's Common Swine Industry Audit, but you may still have questions about how it differs from the Pork Quality Assurance Plus program, which is managed by the National Pork Board.

"The industry has come together on this audit platform with the goal of better serving the needs of farmers, packers, processors, retail and foodservice providers, and consumers," said Sherrie Webb, director of animal welfare for the Pork Checkoff. "The new audit is not a Pork Checkoff program, but rather an initiative led by producers and packers working together to enhance animal care and pork safety."

While Pork Quality Assurance Plus (PQA Plus) and the TQA programs serve as a foundation for the Common Swine Industry Audit, the purposes and outcomes are different. Here's a look.

PQA site assessment:

- Educational and benchmarking tool.
- Measurement and feedback from a trained PQA Plus advisor on the effectiveness of training and management to ensure pig well-being.

Common Swine Industry Audit:

- Objective snapshot by an independent party, with no education component.
- Verification that the pork industry's approved animal well-being standards are being followed.

For more information on PQA Plus or the Common Swine Industry Audit, go to **www.pork.org/commonaudit** or contact Sherrie Webb at **SWebb@pork.org** or 515-223-3533.

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CAUTION: Federal (U.S.A.) law restricts this drug to use by or on the order of a licensed veterinarian. Federal (U.S.A.) law prohibits the extra-label use of this drug in food producing animals.

PRODUCT DESCRIPTION: Each mL of Enroflox 100 contains 100 mg of enrofloxacin. Excipients are L-arginine base 200 mg, n-butyl alcohol 30 mg, benzyl alcohol (as a preservative) 20 mg and water for injection q.s.

INDICATIONS:
Cattle: Enroflox 100 is indicated for the treatment of bovine respiratory disease (BRD) associated with *Mannheimia haemolytica, Pasteurella multocida* and *Histophilus somni* in beef and non-lactating dairy cattle.

Swine: Enroflox 100 is indicated for the treatment and control of swine respiratory disease (SRD) associated with *Actinobacillus pleuropneumoniae, Pasteurella multocida, Haemophilus parasuis* and *Streptococcus suis*.

Enroflox 100 is administered as a single dose for one day (swine) or for multiple days (cattle) of therapy.

Enroflox 100 is not approved for a one-day, single dose of therapy in cattle.

RESIDUE WARNINGS:
Cattle: Animals intended for human consumption must not be slaughtered within 28 days from the last treatment. This product is not approved for female dairy cattle 20 months of age or older, including dry dairy cows. Use in these cattle may cause drug residues in milk and/or in calves born to these cows. A withdrawal period has not been established for this product in pre-ruminating calves. Do not use in calves to be processed for veal.

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

HUMAN WARNINGS: For use in animals only. Keep out of the reach of children. Avoid contact with eyes. In case of contact, immediately flush eyes with copious amounts of water for 15 minutes. In case of dermal contact, wash skin with soap and water. Consult a physician if irritation persists following ocular or dermal exposures. Individuals with a history of hypersensitivity to quinolones should avoid this product. In humans, there is a risk of user photosensitization within a few hours after excessive exposure to quinolones. If excessive accidental exposure occurs, avoid direct sunlight.

PRECAUTIONS:
The effects of enrofloxacin on cattle or swine reproductive performance, pregnancy and lactation have not been adequately determined. The long-term effects on articular joint cartilage have not been determined in pigs above market weight.
Subcutaneous injection can cause a transient local tissue reaction that may result in trim loss of edible tissue at slaughter.
Enroflox 100 contains different excipients than other enrofloxacin products. The safety and efficacy of this formulation in species other than cattle and swine have not been determined.
Quinolone-class drugs should be used with caution in animals with known or suspected Central Nervous System (CNS) disorders. In such animals, quinolones have, in rare instances, been associated with CNS stimulation which may lead to convulsive seizures. Quinolone-class drugs have been shown to produce erosions of cartilage of weight-bearing joints and other signs of arthropathy in immature animals of various species. See Animal Safety section for additional information.

ADVERSE REACTIONS: No adverse reactions were observed during clinical trials.

ANIMAL SAFETY:
In cattle safety studies, clinical signs of depression, incoordination and muscle fasciculation were observed in calves when doses of 15 or 25 mg/kg were administered for 10 to 15 days. Clinical signs of depression, inappetance and incoordination were observed when a dose of 50 mg/kg was administered for 3 days. An injection site study conducted in feeder calves demonstrated that the formulation may induce a transient reaction in the subcutaneous tissue and underlying muscle. In swine safety studies, incidental lameness of short duration was observed in all groups, including the saline-treated controls. Musculoskeletal stiffness was observed following the 15 and 25 mg/kg treatments with clinical signs appearing during the second week of treatment. Clinical signs of lameness improved after treatment ceased and most animals were clinically normal at necropsy. An injection site study conducted in pigs demonstrated that the formulation may induce a transient reaction in the subcutaneous tissue.

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AASV NEWS

Who moved my proceedings?

You won't find the proceedings of the AASV 2015 Annual Meeting in your mailbox this year. Instead, the proceedings are as close as your fingertips and your computer or mobile device! Finding them is easy: go to **https://www.aasv.org/annmtg/proceedings** (or scan the QR code on this page) and follow the directions to download the proceedings in the format most suitable for you. You'll want to make sure your AASV membership has been renewed for 2015, and you'll need your AASV member username and password: if they're not handy, contact the AASV office or use the "Reset Password" link in the upper right of the AASV Web site (**https://www.aasv.org**) to have them e-mailed to you.

The proceedings are available for download as a single PDF, just like the familiar "big book," only in this case, the table of contents is linked to each paper contained in the book. Another option is to use one of our Web apps to download the full set of individual papers to your computer or mobile device. The apps utilize an interactive search feature similar to the one found on previous CD-ROM versions of the proceedings and allow you to access individual papers rather than the full book.

As in the past, all of the proceedings papers are also included in the Swine Information Library on the AASV Web site at **https://www.aasv.org/library/swineinfo/**. This fully-searchable, online library of nearly 12,000 proceedings papers and journal articles is just one of the many benefits enjoyed by AASV members.

So things really haven't changed very much – they've just moved a little.

Emily Mahan-Riggs selected Alternate Student Delegate to AASV Board of Directors

The AASV Student Recruitment Committee is pleased to announce the selection of Emily Mahan-Riggs (North Carolina State University [NCSU], 2017) as the incoming Alternate Student Delegate to the AASV Board of Directors.

Mahan-Riggs' experience in swine medicine did not begin until the summer after her sophomore year of college. She was hired by Dr Randall Prather at the University of Missouri to work with caesarian-derived, colostrum-deprived transgenic and wild-type piglets that would be moved into the National Swine Resource and Research Center. She later created her own line of transgenic pigs to be used for human cardiovascular research. She also interned with Danbred North America (now DNA Genetics) to monitor the terminal traits of their maternal lines of pigs at one of their multiplier facilities. Prior to entering veterinary school, she worked with Dr Dick Hesse at Kansas State University.

Mahan-Riggs is active in the NCSU Student Chapter of the AASV and has sought out many opportunities to meet and shadow swine veterinarians while on breaks. She recently completed a cooperative internship between Prestage Farms and the NCSU College of Veterinary Medicine, troubleshooting seasonal infertility.

After graduating from veterinary school, her main goal as a swine veterinarian will be to effectively care for the health and well-being of all ages of pigs while helping her clients achieve and maintain profitable farms. She also plans to complete the Executive Veterinary Program in Swine Health Management, as well as become a Diplomate of the American Board of Veterinary Practitioners certified in Swine Health Management.

Mahan-Riggs will assume her duties as Alternate Student Delegate during the 2015 AASV Annual Meeting in Orlando. The current alternate delegate, Chris Sievers, will ascend to the delegate position. Chris and Emily will represent student interests within AASV as non-voting members of the board of directors and the Student Recruitment Committee.

Emily Mahan-Riggs

AASV news continued on page 105

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AASV news continued from page 103

Operation Main Street training

Co-sponsored by AASV and the National Pork Board

AASV members like Drs Rick Tubbs, Craig Rowles, Amy Woods, Jeff Harker, Peggy Anne Hawkins, and Gene Nemechek – to name just a few of the 86 veterinarians participating in Operation Main Street (OMS) – are making a difference by sharing the facts about pig care and pork production with veterinary students, dieticians, and civic groups across the United States.

You can join your colleagues in the effort to counter misunderstanding and misinformation about the swine industry by becoming a trained OMS speaker. Operation Main Street speaker training will be held during World Pork Expo in Des Moines, Iowa, June 2 to 5, 2015.

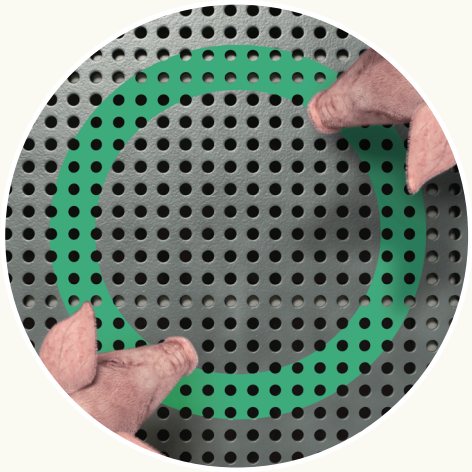
In 2011, AASV and the National Pork Board partnered to train veterinarians as OMS speakers with a goal to schedule a speaker in all 28 schools of veterinary medicine. To date, trained veterinarians have presented at 26 of 28 schools, reaching more than 5000 students through this program.

The training updates participants on what activists are saying about agriculture today and provides attendees with the needed tools and presentations to address those concerns in a science-based, proactive manner. The objective is to equip veterinarians to speak to veterinary students and professional groups, including dieticians. Any AASV member interested in becoming a trained OMS speaker and helping in this endeavor is invited to participate.

For more information, contact Mary Wonders at the National Pork Board at **Mwonders@pork.org** or 515-223-3535.

AASV board breaks with tradition

For perhaps the first time in the history of the association, the AASV Board of Directors will **not** conduct its usual spring meeting during the AASV Annual Meeting. Instead, the board voted to move the spring board meeting to a separate date and location in an effort to enhance the quality and quantity of time spent addressing AASV business. The AASV Committees will continue to meet at the annual meeting, allowing the committee leaders to submit motions and requests for action prior to the board meeting. In this break with tradition, the 2015 spring board meeting will take place Monday, March 30, in Perry, Iowa.



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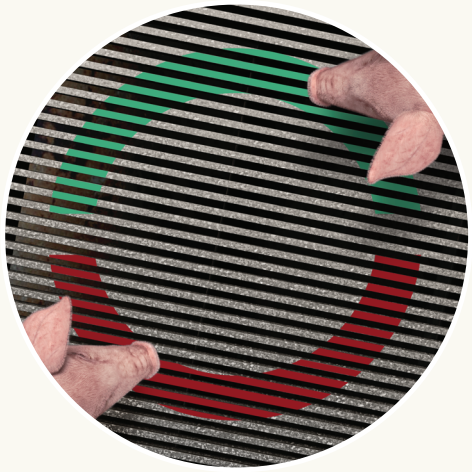

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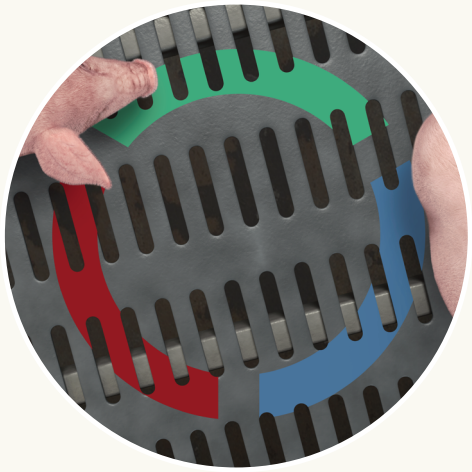

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AASV FOUNDATION NEWS

The AASV Foundation is raffling a "hog"!

Thanks to the generosity of MVP Laboratories, the AASV Foundation is raffling off a brand new 2015 Harley Davidson Street Glide (FLHX) with upgraded faring, reflex-linked brakes with ABS, premium touch-screen radio, security, and cruise control. This beauty is custom-painted Superior Blue and valued at $27,500! Wouldn't the AASV logo look great on those saddlebags??

The motorcycle was purchased and donated to the foundation by MVP Laboratories, so the full value of raffle tickets purchased will benefit the AASV Foundation.

Raffle tickets are only $100 each and can be purchased by contacting AASV or one of the Auction Committee members. Tickets will also be on sale at the AASV registration desk in Orlando.

The lucky winner will be drawn during the Foundation Auction on Monday night, March 2. You don't need to be present to win, but if you feel really lucky, just make a one-way plane ticket to Orlando and plan to drive this beauty home!

NPIF interns matched with swine practitioner-mentors

The AASV Foundation and AASV Student Recruitment Committee are pleased to announce the recipients of the 2015 National Pork Industry Foundation (NPIF) veterinary internship stipends. Six first- and second-year veterinary students were selected from a pool of 78 applicants to receive the $3300 stipends. Each NPIF intern has been linked with a volunteer practitioner-mentor with whom they will spend a 1-month internship during the summer of 2015. The foundation is indebted to the practitioners for their willingness to host and mentor the interns, not only this year but in past years as well.

The interns and their mentors are as follows:

Hunter Baldry, University of Minnesota;
Mentor, Dr Paul Armbrecht, Lake City Veterinary Service, PC

Elizabeth Boyd, Colorado State University;
Mentor, Dr Russ Nugent, Tyson Fresh Meats, Springdale, Arkansas

Bryan Ideus, University of Illinois;
Mentor, Dr Aaron Lower, Carthage Veterinary Service Ltd, Carthage, Illinois

Ben Kasl, Cornell University;
Mentor, Dr Jon Van Blarcom, Lancaster Swine Health Services, Elizabethtown, Pennsylvania

Amanda Neujahr, North Carolina State University;
Mentor, Dr Scanlon Daniels, Circle H Headquarters LLC, Dalhart, Texas

Caitlin Quesenberry, Washington State University;
Mentor, Dr Larry Coleman, Broken Bow, Nebraska

The NPIF veterinary internship stipend program is now in its seventh year. The stipend of $3300 per student defrays the cost of travel, lodging, and compensation during the 1-month internship. Additionally, the interns are encouraged to utilize their practitioner-mentor as a resource throughout the year and to attend the AASV Annual Meeting and Leman Swine Conference in an effort to increase their knowledge and exposure to swine medicine. Each intern submits a written report and evaluation upon completion of the program.

The AASV Student Recruitment Committee developed the NPIF veterinary internship stipend program in an effort to attract veterinary students to swine medicine and to provide interested students with exposure to the life of a swine veterinarian. The $20,000 funding for the program is provided by the National Pork Industry Foundation, a charitable corporation that promotes activities in the swine industry related to research and education. The funds are administered by the AASV Foundation.

AASV Foundation news continued on page 109

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DRAXXIN should not be used in animals known to be hypersensitive to the product.

See Brief Summary of Prescribing Information on the next page.

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AASV Foundation news continued from page 107

Swine Externship Grants available to veterinary students

The AASV Foundation encourages veterinary students with an interest in swine medicine to gain extra-curricular, "hands-on" experience working with swine practitioners in a private practice or production company. The foundation's swine externship grant program, now in its fourteenth year, provides financial support to veterinary students who participate in a qualifying externship. The grants are available year-round and range from $200 to $500 per student, depending upon the actual expenses incurred during the externship.

Veterinary students who plan to complete an externship of at least 2 weeks' duration in a swine practice or a mixed practice with a considerable swine component may apply for the grant. Both the student and at least one member of the hosting practice must be members of the AASV. Members who are willing to host students are encouraged to provide their contact information to AASV for inclusion in the list of externship opportunities on the AASV Web site at **https://www.aasv.org/members/career/internships.php**.

In addition to student information, the grant application requests a letter from the hosting practice containing details of the planned externship. After the externship has been completed and the practice has confirmed the student's participation, the student submits a brief report of his or her experiences, along with expense receipts, to the AASV Foundation before the funds are disbursed.

The grant application is available at **https://www.aasv.org/students/externgrant.htm**, and should be submitted prior to the start of the externship. There is a limit of one grant per student. For more information, contact the AASV Foundation: Tel: 515-465-5255; Fax: 515-465-3832; E-mail: **aasv@aasv.org**.

AASV Foundation Fundraising

AUCTION

Held in conjunction with the AASV Annual Meeting
March 2, 2015 – Orlando, Florida

THANK YOU to the individuals, veterinary practices, and companies who "followed their passion" and contributed to the auction. Since all of the items have been donated, 100% of the auction proceeds will benefit the AASV Foundation!

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www.aasv.org/foundation/2015/auctionlist.php

Everyone can bid!

If you're not attending the AASV Annual Meeting, you can submit your bids by phone (515-465-5255) or e-mail (aasv@aasv.org) prior to February 24.

For information about the AASV Foundation, go to **https://www.aasv.org/foundation**.

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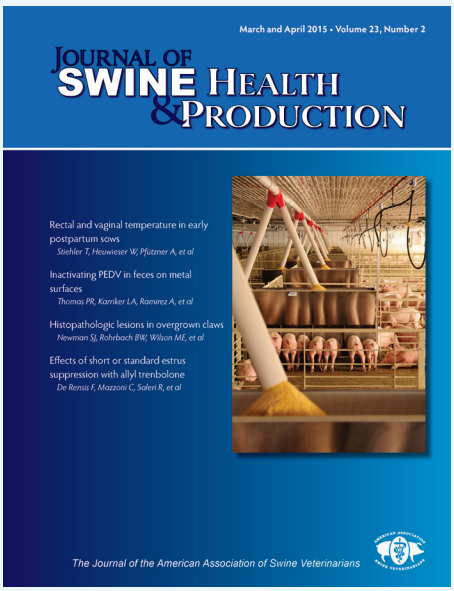

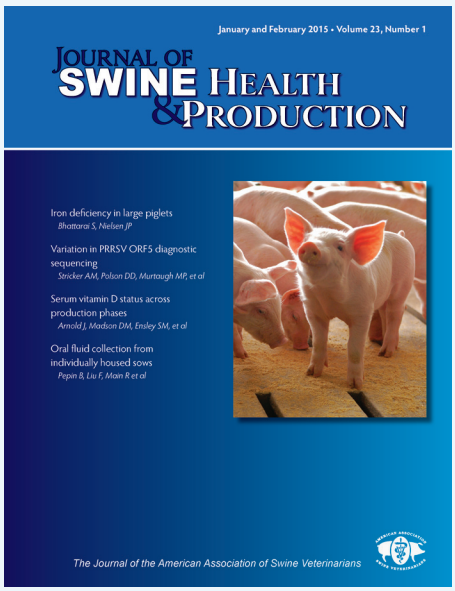

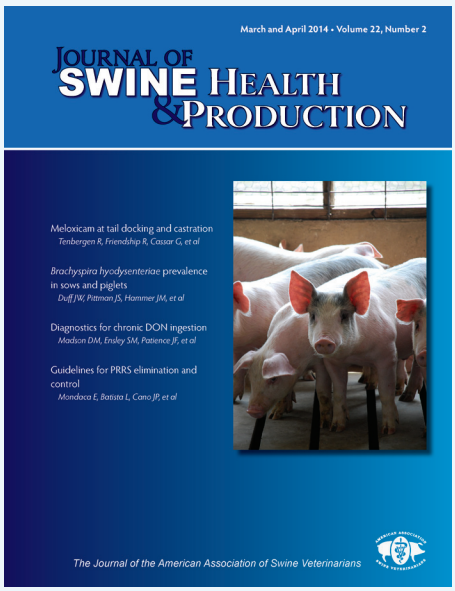

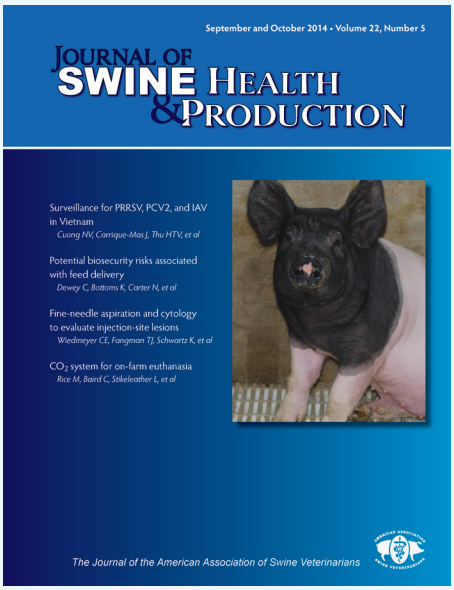

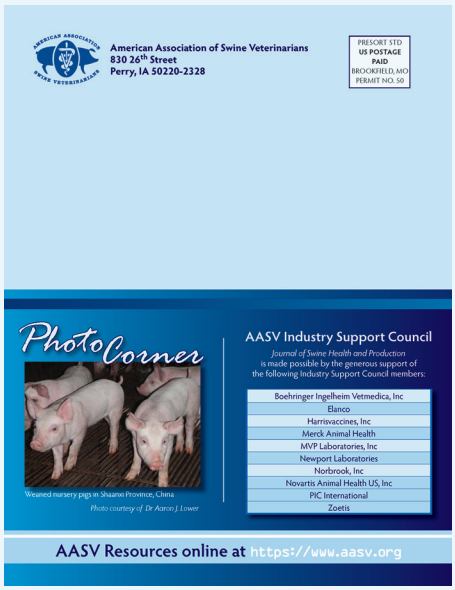

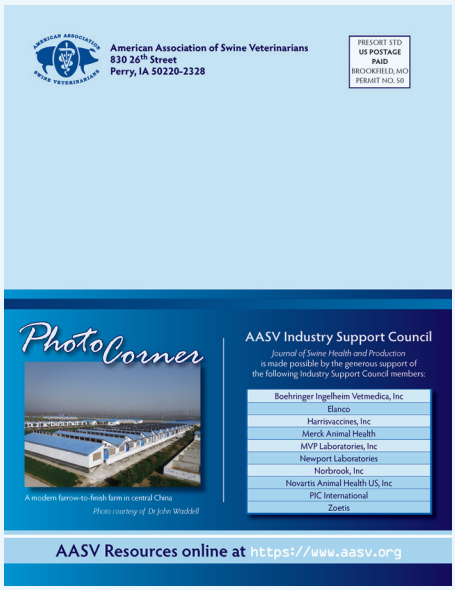

The *Journal of Swine Health and Production* would like to publish digital photographs submitted by our readers. Images used either on the front cover or in the photo corner on the back cover are to represent healthy pigs and modern production facilities. Please ensure that the photos do not include people. Select the largest image size available on your camera, of the quality or compression that allows you to store the fewest images on a given memory card. Do not resize, crop, rotate, or color-correct the image prior to submission to the journal. Please send the images by e-mail attachment to tina@aasv.org. Tina will also need to know your name, affiliation, and the approximate location of the subject, or other details that you would like to submit which describe the image.

Hope springs eternal

The 114th United States Congress was sworn in on January 6, 2015. As we all know, the Republicans now control both houses of Congress while the Democrats lay claim to the Executive Branch. While it's a situation unlikely to eliminate governmental gridlock, every new beginning is at least a chance for temporary optimism. It is always possible that both parties might set aside their desire to blame their failures on the other party and actually accomplish the job the people sent them there to do. Aww, who am I kidding? Following are some random thoughts about the new Congress and issues of importance to swine veterinarians and pork producers.

We now have three veterinarians in Congress: newly elected Ralph Abraham (R-LA) joins Kurt Schrader (D-OR) and Ted Yoho (R-FL). In the 113th Congress, Representatives Schrader and Yoho formed the Veterinary Medicine Caucus, the first such group in the 224-year history of the US House of Representatives.

Caucuses are designed to educate other legislators and help generate awareness and support for specific initiatives. Caucuses can draft and advance legislation, provide congressional testimony, and conduct briefings, events, and hearings. Perhaps this is a group that practitioners can work with to raise awareness about issues of importance to veterinarians.

The American Veterinary Medical Association's (AVMA's) Government Relations Division (GRD) is responsible for lobbying Congress on issues of importance to veterinary medicine. Although the GRD tried, but failed, to push through three major bills – the Prevent All Soring Tactics Act, the Marketplace Fairness Act, and the Veterinary Medicine Loan Repayment Program Enhancement Act – the 113th Congress was not a complete disappointment. President Obama did sign into law

- The Veterinary Medicine Mobility Act, which formally legalizes the drug-dispensing actions of many mobile and rural veterinarians;
- The Farm Bill, a massive package that provides subsidies to farmers and funds an array of veterinary programs, including the National Animal Health Laboratory Network (NAHLN) and the Agriculture and Food Research Initiative; and
- The Animal Drug and Animal Generic Drug User Fee Reauthorization Act, which permits the US Food and Drug Administration to collect fees from drug makers and fund faster reviews of new and generic animal drugs.

So what are some issues of importance to swine veterinarians and pork producers facing the newly seated Congress? We were successful getting funding authorized in the Farm Bill to support enhancements to the NAHLN. One thing the porcine epidemic diarrhea virus outbreak has shown us is the importance of an effective, efficient laboratory network that has access to necessary diagnostics and the trained personnel to conduct the testing.

In addition, we have seen the importance of rapid electronic communication between member labs, the National Veterinary Services Laboratory, state and federal animal-health officials and the NAHLN. Enhancing the NAHLN infrastructure hinges on convincing 1) Congress to appropriate the $15 million authorized in the Farm Bill and 2) the US Department of Agriculture to prioritize information technology and laboratory infrastructure.

Trade issues and immigration are also critical to pork producers and US agriculture. In the works are the Trans-Pacific Partnership (TPP) and the Trans-Atlantic Trade and Investment Partnership, which would standardize work rules, environmental impact thresholds, and other regulatory differences among partner countries. The National Pork Producers Council is asking the Obama administration to urge TPP countries to remove tariffs on pork and sanitary-phytosanitary barriers to trade, as well as to accept US plant inspections as equivalent to the inspection systems in each TPP nation.

Antimicrobial use issues will also likely emerge again during this Congress. There will likely be calls to further restrict the approved uses of antimicrobials in food-producing animals, as well as efforts to access additional data on on-farm antimicrobial use. While a Republican Congress is perhaps less likely to pass additional restrictive legislation, the Food and Drug Administration is seeking to modify the National Antimicrobial Resistance Monitoring System to better understand the impact of activities occurring on the farm and subsequent movements of resistant bacteria through the processing facilities and into retail meats. The USDA is working with researchers to evaluate possible mechanisms for accessing more on-farm data on antibiotic use as well. Veterinarians and producers will actively monitor these issues and work to engage government agencies as necessary.

The AVMA-GRD will likely pursue the Veterinary Medicine Loan Repayment Program Enhancement Act again. This proposed legislation would make the veterinary medicine loan repayments tax exempt. Currently, 39% of the total funds appropriated are immediately taken off the top to pay taxes on the disbursements. Gaining tax exempt status would allow additional award opportunities.

These are a few of the key legislative and regulatory issues AASV will be watching in 2015. Lobbyists from the barnyard are going to be busy trying to educate all the new congressional representatives and reminding the old guard about why these issues are important.

Harry Snelson, DVM
Director of Communications

Position announcement: Swine Production Medicine and Entrepreneurship

The College of Veterinary Medicine at Iowa State University is seeking applications for a full-time, tenured, tenure-track, or clinical track position in the department of Veterinary Diagnostic and Production Animal Medicine (VDPAM). Applications will be accepted at the clinician or senior clinician, assistant, associate, or full professor levels. The person in this position will provide outreach and professional services to producers and veterinarians on current production and health issues facing the US and global pork industries. Teaching responsibilities will include coordinating the veterinary entrepreneurship and the veterinary practice management courses, both of which extensively utilize outside speakers. This position will also contribute selected lectures and assist with labs in other courses in the veterinary professional and animal science curriculum. The person in this position is expected to establish an independent or collaborative research program in areas of clinical relevance to the US pork industry. Please refer to **www.iastatejobs.com**, posting number 400137, to view the complete position description and requirements and to apply online. To ensure consideration, applications must be submitted online by March 15, 2015. Questions about the position can be directed to the search committee chair, Dr Derald Holtkamp (515-294-9611; **holtkamp@iastate.edu**), or VDPAM chair, Dr Pat Halbur (515-294-6970; **pghalbur@iastate.edu**). Iowa State University is an EO/AA employer. All qualified applicants will receive consideration for employment without regard to race, color, religion, sex, national origin, disability, or protected veterans status.

Position announcement: Staff veterinarian

PFFJ Farms, LLC, seeks a staff veterinarian to be responsible for maintenance of herd health programs for farm operations located in Arizona and California and to oversee outside veterinarian contractors for operations in Colorado and Wyoming. The position reports to the Vice President of Operations and is located in Snowflake, Arizona. Qualifications include a DVM from an accredited veterinary college, highly developed organizational, planning, and management writing skills, superior listening skills, and strong interpersonal skills. Experience in a multidisciplinary environment and in swine medicine/production are required, with sound veterinary practical skills, a working knowledge of pork production systems, and knowledge of a variety of computer software applications in word processing, spreadsheets, database, and presentation software (MS Word, Excel, Word Documents, and PowerPoint).

The staff veterinarian will be responsible to create, supervise, and coordinate herd health programs that will enhance throughput; monitor and implement procedures that will enhance biosecurity to ensure high health status; provide expertise in diagnosis and troubleshooting; assist in implementation of employee production education programs; remain current in the area through establishing a network of industry and academic contacts; study industry literature and attend scientific/industry meetings; and hold confidential all proprietary knowledge. Frequent travel required.

Submit resume to **showard@pffjfarms.com** or to PFFJ, LLC, PO Box 398, Taylor, AZ 85939; attention Susan Howard.

Upcoming meetings

American Association of Swine Veterinarians 46th Annual Meeting

February 28-March 3, 2015 (Sat-Tue)
Buena Vista Palace Hotel & Spa, Orlando, Florida

For more information:
American Association of Swine Veterinarians
830 26th Street, Perry, IA 50220-2328
Tel: 515-465-5255; Fax: 515-465-3832
E-mail: aasv@aasv.org
Web: https://www.aasv.org/annmtg

National Institute for Animal Agriculture Annual Conference

March 24-25, 2015 (Tue-Wed)
Hyatt Regency Hotel, Indianapolis, Indiana

For more information:
National Institute for Animal Agriculture
13570 Meadowgrass Drive, Suite 201
Colorado Springs, CO 80921
Tel: 719-538-8843; Fax: 719-538-8847
E-mail: niaa@animalagriculture.org
Web: http://www.animalagriculture.org

World Pork Expo

June 3-5, 2015 (Wed-Fri)
Iowa State Fairgrounds, Des Moines, Iowa

Hosted by the National Pork Producers Council

For more information:
Alicia Newman
National Pork Producers Council
10676 Justin Drive, Urbandale, IA 50322
Tel: 515-864-7989; Fax: 515-278-8014
E-mail: irlbecka@nppc.org
Web: http://www.worldpork.org

International PRRS Congress

June 3-5, 2015 (Wed-Fri)
Ghent, Belgium

For more information:
E-mail: prrs2015@ugent.be
Web: http://www.prrscongress.ugent.be/

7th International Symposium on Emerging and Re-emerging Pig Diseases

June 21-24, 2015 (Sun-Wed)
Kyoto International Conference Center, Kyoto, Japan

For more information:
E-mail: iserpd2015@ics-inc.co.jp
Web: http://emerging2015.com

VIIIth International Conference on Boar Semen Preservation

August 9-12, 2015 (Sun-Wed)
Hilton Garden Inn, Urbana-Champaign, Illinois

Hosted by the University of Illinois

For more information:
Web: http://boarsemen2015.com/

24th International Pig Veterinary Society Congress

June 6-10, 2016 (Mon-Fri)
Dublin, Ireland

For more information:
Web: http://www.ipvs2016.com

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

American Association of Swine Veterinarians
830 26th Street
Perry, IA 50220-2328

Photo Corner

Curious Iowa finishers

Photo courtesy of Tina Smith

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