3rd European Symposium of Porcine Health Management

MAY 25TH – 27TH, 2011 DIPOLI CONGRESS CENTER, ESPOO FINLAND

UNIVERSITY OF HELSINKI
FACULTY OF VETERINARY MEDICINE

ECPHM EUROPEAN COLLEGE OF PORCINE HEALTH MANAGEMENT

PROCEEDINGS

THE 3RD EUROPEAN SYMPOSIUM OF PORCINE HEALTH MANAGEMENT

25TH - 27TH MAY 2011

DIPOLI CONGRESS CENTER

ESPOO, FINLAND

Content

THE 3RD EUROPEAN SYMPOSIUM ON PORCINE HEALTH MANAGEMENT

The 3rd ESPHM is organized in Espoo, Finland on May 25-27, 2011. This symposium has evolved as an important meeting for pig practitioners as well as other professionals working with porcine health management. The board of the European College of Porcine Health Management discussed and carefully planned the first meeting, which took place in Copenhagen in 2009. The board felt that there was a true need for a European meeting for veterinarians that are active in this area. This had been indicated in previous congresses as well as in annual general meetings by the college. The college had its first annual general meeting in Brussels in 2004. Ever since the college has taken the initiative to organize and support professional residency programs in several European universities with the aim to support practitioners and other professionally active veterinarians specializing in porcine health management.

Residency programs can be well defined programs with exact counts of activities within the field. They can also be so called alternative programs with a more flexible contents but still clearly demonstrated professional excellence in this field. The programs will need to cover the various subfields of porcine health management, such as diseases, pathology, reproduction, animal welfare and animal production. A few veterinarians, mainly from the mid European countries, have already gone through the residency programs and they have taken the final examination to demonstrate their skills and knowledge in porcine health management. The details regarding the residence programs and other activities of the college can be found at the web pages of the college at www.ecphm.org – you may also look up for the most relevant residence institute.

The symposium in Espoo will focus on various actual aspects of porcine health management such as udder development and milk production of the sow, the function of the udder is also dealt with from the clinical point of view. In addition, tail biting will be in the focus as well as lameness, salmonellosis and vaccination programs.

The newest scientific findings will be discussed along with the 100 symposium papers from all over Europe. Finland is known for well organized and secure congresses. The flora of this Nordic country is starting to blossom in the end of May, when the forests and the nature on the cost line of Southern Finland is at best – it is as green as it can possibly get. Another unique experience is light nights at this time of the year and the gala dinner at a cozy location at sea will provide with an excellent opportunity to experience that together with the delegates from all over Europe, already known from the two previous symposiums on porcine health management.

Typical Finnish music and excellent food provided at the gala dinner will make sure you will remember the 3rd ESPHM. You are most welcome to Finland and Espoo, we have been waiting for you and we promise to do our best to make your trip a successful one, both socially and professionally!

Prof. Olli Peltoniemi, President ESPHM

On behalf of the Organizing Committee

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ACKNOWLEDGEMENTS

The input of Johanna Vappula, Katri Luomanpää and Jan Fagerström, our congress organizers, is hereby acknowledged with sincere thanks. We had always great deal of joy while working with these experts for the ESPHM. The visual image and editing of the present proceedings was carried out by Elina Viitasaari and Leila Mäkinen, who are acknowledged with gratitude.

The president of the ECPHM, Dominiek Maes and the rest of the board of the ECPHM actively participated in planning the symposium, which was highly appreciated by the local organizing committee. Last but not least we would like to thank our sponsors, Boehringer Ingelheim Animal Health GmbH, Elanco – Eli Lilly & Company Ltd, Intervet / Schering-Plough, Janssen Animal Health, Merial, Novartis Animal Health Inc., Orion Pharma Animal Health and Pfizer Animal Health, for making the congress financially possible.

Local organizing committee

PROGRAMME
WEDNESDAY MAY 25, 2011

08.00-15.00	Golf tour	Vihti
11.00-15.00	University tour	Helsinki
	or Sow pool tour	Vihti
08.00-10.30	ECPHM, board meeting	Symposium venue
10.30-12.00	EAPHM, board meeting	
12.00-15.00	ECPHM+EAPHM boards, joint meeting	
15.00-16.30	ECPHM, Annual General Meeting	
16.30-18.00	EAPHM, Annual General Meeting	
14.00-20.00	Registration	
18.00-20.00	Get together party	

THURSDAY MAY 26, 2011

08.30-08.45	**Opening Ceremony**	Prof. Olli Peltoniemi, University of Helsinki
08.45-09.00	**Finnish pig industry**	Dr. Taneli Tirkkonen, Atria Ltd.
SESSION 1	**LAMENESS under the spotlight**, Chair: Mari Heinonen	
09.00-09.50	**Diagnosis of lameness**	Senior project coordinator Elisabeth Okholm-Nielsen, Danish Slaughterhouses, Denmark
09.50-10.10	**Risk factors and prevention of lameness**	Prof. Michael Wendt, University of Veterinary Medicine, Hannover, Germany
10.10-10.30	**Round table discussion**	
10.30-11.00	**Coffee break**	
SESSION 2	**TAIL BITING: The biter, the victim and the money**, Chair: Jens Peter Nielsen	
11.00-11.50	**What do we know about tail biting today?**	Prof. Sandra Edwards, Newcastle University, UK
11.50-12.10	**The consequence of a tail biting outbreak**	Project coordinator Camilla Munsterhjelm, University of Helsinki, Finland
12.10-12.30	**Round table discussion**	
12.30-13.15	**Lunch**	
13.15-14.00	**Posters.** The presenters of posters with uneven numbers (1, 3, 5, ...) are close to their stands.	
SESSION 3	**REPRODUCTION, attention to milk!** Chair: Olli Peltoniemi	
14.00-15.00	**Factors affecting milk production and mammary development in swine**	Research scientist Chantal Farmer, Agriculture and Agri-Food, Canada
15.00-15.20	**Challenges of milk production from the clinical point of view**	Prof. Dominiek Maes, Ghent University, Belgium
15.20-15.30	**Round table discussion**	
15.30-16.00	**Coffee break**	
SESSION 4	**ECPHM Resident presentations**, Chair: Paolo Martelli	
16.00-16.10	**Long duration of farrowing affects fertility of sows**	Claudio Oliviero, University of Helsinki, Finland
16.10-16.15	Discussion	
16.15-16.25	**Increased quantitative excretion of Lawsonia intracellularis is associated with decreased average daily gain in weaned pigs**	Ken Steen Pedersen, University of Copenhagen, Denmark
16.25-16.30	Discussion	
16.30-16.40	**Efficacy of chlortetracycline against a clinical outbreak of resp. disease in fattening pigs**	Rubén Del Pozo Sacristán, Ghent University, Belgium
16.40-16.45	Discussion	
16.45-16.55	**Effect of PCV2 maternally derived anti-bodies on serum viral load in post-weaning multisystemic wasting syndrome affected farms**	Sergio López-Soria, Universitat de Lleida, Spain
16.55-17.00	Discussion	
18.30	**Buses leave** from the symposium hotels to Symposium Dinner	
19.00-24.00	**Symposium Dinner**	

FRIDAY MAY 27, 2011

SESSION 5	**SELECTED POSTER PRESENTATIONS**, Chair Tomasz Stadejek	
09.00-09.15	**Differences in growth reduction in finishing pigs with diarrhea**	Markku Johansen, Pig Research Centre, Danish Agriculture & Food Council, Denmark
09.15-09.20	Discussion	
09.20-09.35	**Ethical, environmental and economical aspects on health status of pigs**	Per Wallgren, National Veterinary Institute, Sweden
09.35-09.40	Discussion	
09.40-09.55	**Economical analysis of PRRSv-outbreaks of in Nine Sow Herds**	Arie Van Nes, Utrecht University, The Netherlands
09.55-10.00	Discussion	
10.00-10.15	**Persistence of methicillin resistant Staphylococcus aureus (MRSA) after cleaning and disinfection procedures in pig holdings**	Merialdi Giuseppe, The Lombardy and Emilia Romagna Experimental Zootechnic Institute, Italy
10.15-10.20	Discussion	
10.20-10.50	**Coffee break**	
SESSION 6	**SALMONELLA, update on important facts**, Chair Thomas Blaha	
10.50-11.40	**Salmonella; update on pathogen - host interaction and control measures**	DVM Filip Boyen, Ghent University, Belgium
11.40-12.10	**Role of nutrition on salmonella prevention**	Prof. Josef Kamphues, University of Veterinary Medicine, Hannover, Germany
12.10-12.30	**Round table discussion**	
12.30-13.15	**Lunch**	
13.15-14.00	**Posters.** The presenters of posters with even numbers (2, 4, 6, ...) are next to their stands.	
SESSION 7	**APPLIED IMMUNOLOGY**, Chair Joaquim Segales	
14.00-14.40	**Immunization by vaccination of pigs**	Researcher Enric Mateu de Antonio, CReSA, Spain
14.40-15.00	**How to design vaccination programs to pig herds**	DVM Enric Marco, Marco i Collell, Spain
15.00-15.20	**Round table discussion**	
15.20-15.25	**ESPHM 2012 Belgium**	Prof. Dominiek Maes
15.25-15.30	**Closing Ceremony**	Prof. Olli Peltoniemi

GENERAL INFORMATION

REGISTRATION AND INFORMATION DESK

Participants can pick up their personal symposium material at the registration desk, which will be open at Dipoli Congress Centre (lobby area, ground floor) as follows:

Wednesday, May 25	14.00-20.00hrs
Thursday, May 26	07.30-17.30hrs
Friday, May 27	08.30-16.00hrs

Please note that only registered participants may attend the scientific sessions and the social events offered by the symposium.

EXHIBITION

The organizers invite all participants to visit the symposium exhibition at Dipoli Congress Centre. The exhibition is open as follows:

Thursday, May 26	08.00 Opening of the exhibition
Friday, May 27	15.30 Closing of the exhibition

ESPHM2011 SYMPOSIUM TRANSPORTATION

Bus transportation for the ESPHM2011 Symposium participants as follows:

Thursday, May 26 (for Symposium Dinner)

17.15hrs	from Dipoli Congress Centre to Sokos Tapiola Garden Hotel
18.30hrs	from Sokos Tapiola Garden Hotel and Hotel Radisson Blu Espoo to Symposium Dinner
23.30hrs, 24.00hrs	from Symposium Dinner to Sokos Tapiola Garden Hotel and Hotel Radisson Blu Espoo

NAME BADGE

Your personal name badge is your entrance ticket to all sessions and other activities of the symposium. Please wear this badge at all times.

SMOKING POLICY

Smoking is not allowed inside the symposium venue.

LUNCH AND COFFEE

Coffee/tea and a buffet lunch are served free of charge (for delegates & exhibitors) at the Symposium venue on Thursday and Friday during the symposium breaks.

INSURANCE

The symposium organizers cannot accept liability for personal injuries sustained, for loss of, or damage to property belonging to symposium participants (or their accompanying persons), either during or as a result of the symposium. Please check the validity of your own travel insurance.

LIABILITY

The Symposium Organization and the Conference Agency (Confedent Oy) act as agents only in securing hotels,transport and travel services and shall in no event be liable for acts or omissions in the event of injury, damage, loss, accident, delay of irregularity of any kind whatsoever during arrangements organised through contractors or the employees of such contractors in carrying out services. Hotel, tour and transportation services are subject to the terms and conditions under which they are offered to the public in general. The Symposium Organization and the Conference Agency reserve the right to make changes where deemed necessary without prior notice to parties concerned. All disputes are subject to Finnish Law.

FINLAND IN A NUTSHELL

Area: 338.145 square kilometers
Population: approx. 5.200.000
Capital: Helsinki, population 577.000 inhabitants
Local time: GMT + 3 hours
Finland has been a member state of the EU since 1995.

TELEPHONES

The country code for Finland is +358.
The code for the city of Helsinki is (0)9.

CURRENCY, BANKS AND AUTOMATIC CASH DISPENSER

The monetary unit used in Finland is the Euro. Most Finnish services accept major credit cards. Facilities for cashing travellers' cheques in Finland are available at banks and at most hotels. Banks are closed on Saturdays and Sundays except for banks at the Helsinki International Airport. Foreign exchange agencies for example "Forex" in the city center are open on weekdays.Use the automats called "OTTO" for bank or credit card (VISA, Eurocard, Mastercard) withdrawals.

ELECTRICITY

The electric current in Finland is 220V (50 Hz). Plugs and sockets are the same as in the Continental countries of the European Union. British and American participants need plug adapters for electrical appliances.

PHARMACY & SHOPS

Yliopiston Apteekki in the Helsinki City Centre, address: Mannerheiminitie 96, is open 24 hours a day. Pharmacies are marked with the sign "Apteekki". In the Helsinki City Centre most shops are open from 09.00 to 20.00 on weekdays, from 09.00 to 18.00 on Saturdays and from 12.00 to 18.00 on Sundays.

TRANSPORTATION

Public Transportation Tickets and fares

The metropolitan area (Helsinki, Espoo, Kauniainen,Vantaa plus Kerava and Kirkkonummi) has a unified fare system. The region is divided into three tariff zones. You can travel with Helsinki region travel card or with single tickets bought from ticket machines, the bus driver or train conductor on all local buses and trains.
It entitles you to unlimited travel on all buses, trams, metro and local trains in Helsinki and Espoo. The tourist ticket is valid for 1, 3 or 5 days. Tickets are for sale in most of the hotels, at Stockmann's department store and R-Kiosks in the City centre, Tapiola and Otaniemi campus area. 1-day tourist tickets can be bought on buses, local trains and from multi-ticket machines. Single city tickets are available on buses but not trams.

Timetables

Schedules of regional lines in Helsinki, Espoo and all public transport on metropolitan area you will find on **www.ytv.fi**.

TAXIS

Taxis can be hailed in the streets or ordered by phone:
+358 100 700 (Helsinki)
+358 100 7300 (Espoo, Otaniemi)

IMPORTANT PHONE NUMBERS

Emergency phone 112

Helsinki City Tourist Office phone +358 9 3101 3300
Pohjoisesplanadi 19 e-mail:tourist.info(at)hel.fi www.visithelsinki.fi
Opening hours: Mon-Fri 09.00-20.00, Sat-Sun 09.00-18.00

Espoo Tourist Information phone +358 9 8164 7230
Keskustorni 10th floor, Tapiola 02100 Espoo
Email: tourist(at)espoo.fi
www.visitespoo.fi
Opening hours: Mon-Fri 09.00 - 16.00

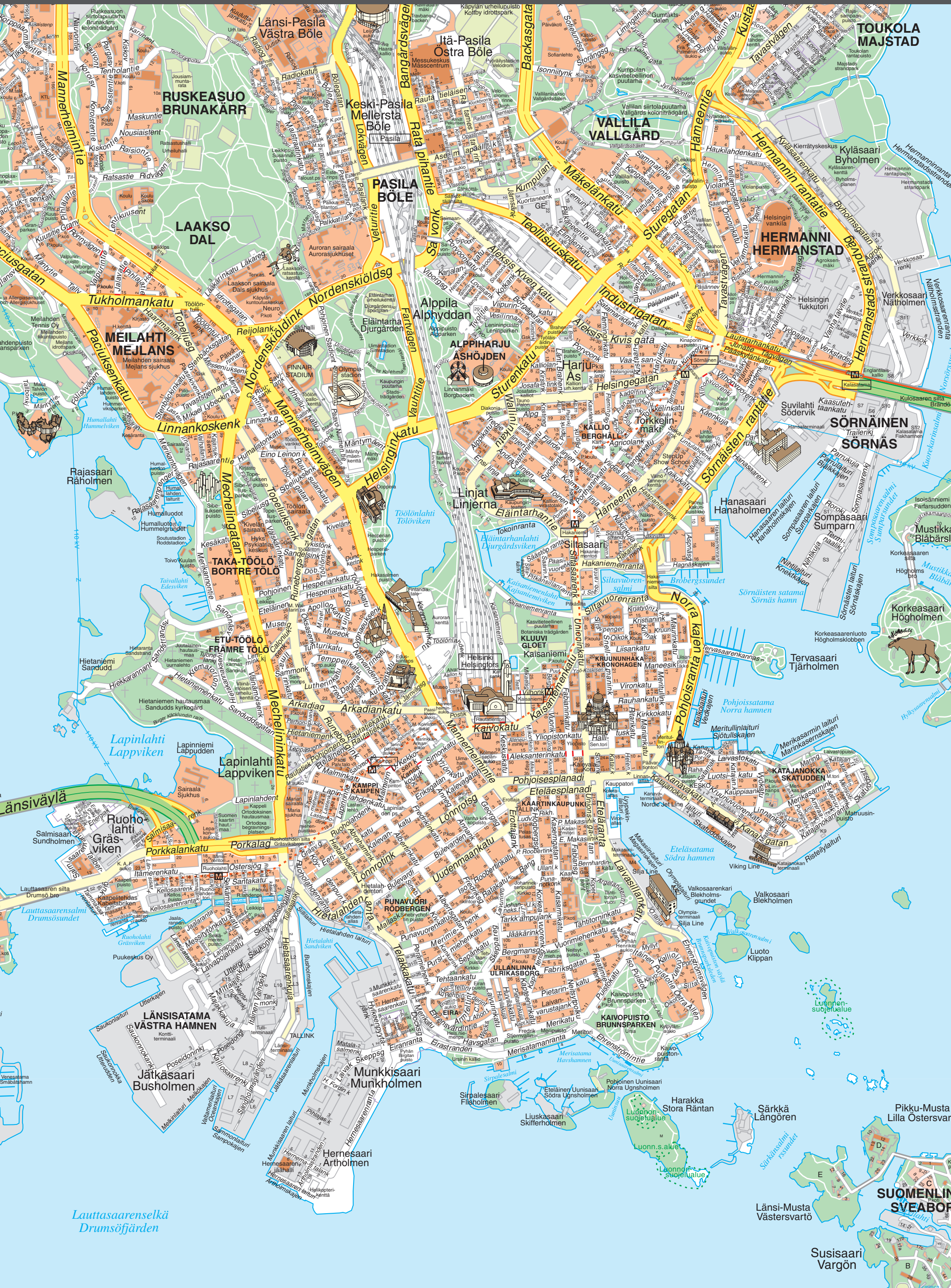
MAP OF HELSINKI CITY CENTRE

1. **Sokos Hotel Tapiola Garden**
Address: Tapionaukio 3,
02100 Espoo
tel: +358 20 1234616

2. **Radisson SAS Hotel Espoo**
Address: Otaranta 2,
02150 Espoo
tel: +358 20 1234705

3. **Dipoli Congress Centre**
Address: Otakaari 24,
00076 AALTO
tel: +358 9 470 24667

4. **Poliisien Kesäkoti**
SYMPOSIUM DINNER
Address: Kyyluodontie 1,
Lauttasaari



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Mellersta
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Harakka
Stora Räntan
Särkkä
Långören
Liuskasaari
Skifferholmen
Sirpalesaari
Flisholmen

Keynote lectures

DIAGNOSIS OF LAMENESS

Elisabeth Okholm Nielsen, Danish Slaughterhouses, Denmark

The diagnosis of lameness poses a daily challenge to all veterinary surgeons who work in the field. Lameness occurs in all ages of pigs – in all systems, both indoor and outdoor – in every pig-producing country. Lameness results in loss of mobility and reduces the welfare of the animals; it reduces the productivity of the herd and may result in the loss of individual animals because they have to be put down.
Diagnostic work is rather like detective work, in that you gather information from the stockperson on how this or that animal looked yesterday, the history of other cases in the herd and your own observations of one or more lame animals. You then decide on a diagnosis and determine how the animals should be treated. If possible, you also consider how this kind of lameness should be prevented in the future. In this paper, I will take you through a number of selected types of lameness and discuss the possibilities of diagnosis. I will concentrate on the most common causes of lameness in industrial pig production in Europe.

Lame piglets

Lameness in piglets is an everyday occurrence in the farrowing unit in most herds. When observed, these small animals appear to be very lame. They are often seen walking – or even running – on three legs. The fourth leg is often very swollen and warm to the touch. If it is a single piglet in the litter, there are two likely causes of this kind of lameness: an infectious arthritis or a severe trauma or fracture. You should then try to establish whether the leg is broken, in which case the piglet should be put down. In most cases, lame piglets are treated with antibiotics, often penicillin. We do not have any diagnostic tests that can be performed in this situation. When gathering information for the diagnosis, we look for patterns. In order to select preventive measures, we look for some kind of patterns in both the individual pig and groups of pigs. Do all the lame piglets come from primiparous sows? Are they from one housing unit on the farm? Is it always the right hind leg? These patterns may lead to a better diagnosis. In the latter case, the ani-mal could be affected by trauma to the right hind leg due to inappropriate handling. Trauma and infectious arthritis are the main causes of lameness in piglets. The infections are various, e.g. Escherichia coli, Streptococcus ssp., Arcanobacterium pyogenes, all of which can be seen as opportunistic pathogens. There might be infected injuries on legs, clipped teeth, castration wounds or navel infections that develop into septicaemia and arthritis.

Lame weaner pigs

At weaning, the litters are often mixed and the weaner pigs are housed in pens holding between 30 and more than one hundred weaner pigs. This poses a challenge to the stockperson and the veterinary surgeon when attending lame weaners. When a large group of pigs is held in a pen, it is difficult to observe single pigs. On the other hand, if you isolate an individual pig for observation, for example.in the alley, the pig might be uncomfortable and will not show signs of mild lameness, and even severe lameness may be disguised if the pig is anxious. The solution is to take your time and observe the pigs in the pen once they have calmed down.

Lameness is not usually the main problem in weaner pigs. However, young pigs are likely to pick up many infectious diseases, such as diarrhea, pneumonia and general infections. Although lameness is sometimes a predominant health problem, close obser-vation of lameness usually helps to spot other signs of illness as well as lameness. Lame weaner pigs may have warm swollen legs or visibly injured claws or feet. Sometimes, you just see a lame pig with nice, dry limbs. In these cases, you must suspect injury or infection in the upper part of the legs, the elbow or shoulder in the front limbs, the knee or hip joint in the hind limbs, or in the back of the animal. These joints can be severely affected without showing any external signs.

In some countries, the veterinary surgeon is allowed to perform an autopsy in the herd. This provides additional information for the diagnosis. Obvious signs of trauma, fracture and infectious arthritis can be observed right away, and material can be submitted for laboratory diagnosis. Cases of lame weaner pigs investigated at the diagnostic laboratory often show infectious arthritis as the primary cause of lameness. Infectious arthritis can be due to pathogens. In weaners, we more often find Streptococcus ssp, Hae-mophilus parasuis or opportunistic pathogens such as E.coli.

Lame finishers/gilts

Lameness is less prevalent in finisher herds. In some herds, the prevalence is close to zero, while in other herds lameness is a more common problem. Among finishers, we have cases of lameness occurring over several weeks, with a chronic presentation. The stockperson will pay particular attention to lameness among young breeding animals. These pigs, finishers or gilts, may have a stiff gait with short steps, and their posture may be altered from straight legs to more buck-kneed front legs, upright pasterns on the rear feet and swaying hindquarters. These cases should be diagnosed in some way, e.g. by performing an autopsy in the herd or submitting material to the diagnostic laboratory. It is important to clarify whether or not these cases of lameness are due to infections. In gilts and finisher pigs, we can expect to find osteochondrosis, chronic erysipelothrix infection (erysipelas). In these cases, antibiotics will be of no use, and treatment with painkillers may be the best treatment we can offer. Gilts with this stiff gait should be sent for slaughter; they will not serve as future good sows with sound legs.

We also see cases of acute lameness in finishers and gilts. Joint infections in the elbow/shoulder and knee/hip joint are difficult to pinpoint. Infection with Mycoplasma hyosynoviae results in an acute severe lameness, where the pig prefers to sit or lie down. This infection is seen throughout the grower-finisher period and in young gilts. The gross pathology of Mycoplasma hyosynoviae may be difficult to establish, as it is merely an abundant reddish synovial fluid in the joint. Treatment with tetracycline, macrolide or pleu-romutilin injections for a few days cures the lameness. Penicillin has no effect on mycoplasma arthritis.

Table 1. Diagnostic measures rated according to usefulness by the author

	Clinical examination	Autopsy	Culture	Serology
Trauma	+	+		
Claw lesions	++	++		
Fracture	+++	++		
Osteochondrosis	+	+++		
Arthrosis	+	+++		
Osteomyelitis	+	+		
Meningitis	+	+	+	
Arthritis, E.coli	++	++	+++	
Arthritis, Streptococ-cus ssp.	++	++	++	
Arthritis, M. hyosyn-oviae	++	+	+	
Arthritis, H. parasuis	++	+	+	+
Arthritis, E. rhusiopa-thiae	++	+++	(+)	(+)
Poisoning	+	(+)		

Lame sows

Diagnosis of lameness in sows is a more difficult field. First of all, you have to know how to recognise a lame sow. For instance, a sow will put some weight on a sore leg, instead of walking on three legs like a piglet, simply due to her weight. You have to observe her closely. Does she distribute weight on her legs evenly? Does she take short steps? Is she reluctant to move? If the sow is stressed, for example by being alone in an alley, she will not display mild lameness. She might run, which makes it almost impossi-ble to evaluate lameness. The claws are easily examined in lying sows. You often observe a high prevalence of various lesions in the claws, e.g. cracks, overgrown heels, overgrown claws, uneven claws and missing dewclaws. Only overgrown claws are report-ed to be related to lameness.

When it comes to further diagnosis by autopsy and microbiological investigation or even histopathological investigation, it seems that the bigger the animal is, the fewer the number of cases will be investigated – it is simply too laborious. Records from Danish herds show that lameness is the number one reason for putting down a sow in the herd, with an average of 4% of the sow popula-tion being put down for this reason on a yearly basis. Arthrosis seems to be the

cause of lameness in many sows, whereas in some herds claw lesions with or without secondary infection are abundant.
In a recent investigation, we performed weekly evaluations of the gait of sows in the gestation period in two Danish herds with many cases of leg problems. Forty-two lame sows were selected for autopsy at a diagnostic laboratory. The autopsy showed that half of the sows had arthrosis, predominantly in the elbow and knee joints. An investigaton of the weekly evaluations of sows with arthrosis showed varying degrees of lameness over the gestation period. Claw lesions and torn dewclaws with infection in the area were found in a quarter of the investigated sows. However, claw lesions were seen in non-lame sows. The importance of claw lesions in relation to lameness is easily exaggerated when the lesions are easily observed in comparison with joint problems.

Antibodies
The surgeon would like to have some diagnostic tools, for example a test for specific antibodies in serum samples. Some diagnos-tic laboratories perform tests of H. parasuis antibodies (CF test in Denmark) and Erysipelothrix rhusiopathiae antibodies. It may have to be paired samples. The Veterinary Institute in Denmark has an antibody test for M. hyosynoviae for research; however, it does not meet the demands of a field setting. Generally, serology is of very little use in the diagnosis of lameness.

Acute phase proteins
Several groups have used acute phase protein tests. Their results show that pathological changes causing lameness affect the level of acute phase proteins such as haptoglobin and C-reactive protein. Although the acute phase protein is by nature non-specific, it may be possible to investigate infections. Testing for acute phase proteins has not yet found its place in the surgeon’s toolbox.

Biomarkers and x-ray
Osteochondrosis has been investigated using x-ray, the picture of the bone in the joint giving an indication of the cartilage changes. However, this is impractical, and even with a handheld device it will be difficult to evaluate the pictures. Some investigations have compared various biomarkers of cartilage synthesis and degradation to macroscopic osteochondrosis. This measure is not ready for use since we know that a high proportion of finishers have cartilage changes with no sign of lameness. Therefore, further inves-tigation is necessary before we can use biomarkers as a diagnostic measure.

Autopsy
Performance of post-mortems on pigs/sows with a history of lameness can give very good information and lead to diagnosis. The pathologist must be experienced or discus the findings with others with experience. However, the pathological diagnosis may not explain the observed clinical lameness. The locomotory system is complicated, and even a very thorough examination may not include

every muscle, tendon and small joint. Therefore, a negative pathological diagnosis could be due to an overlooked cause. On the other hand, we see changes in, for example, osteochondrosis in the joints of pigs not showing lameness. In sows, we see intermittent lameness in individuals with arthrosis. So even though the autopsy provides a good diagnosis, you cannot regard it as an absolute diagnosis in all cases.

Clinical examination

Diagnosis of lameness is totally dependent on the clinical skills of the surgeon. This is a field in which excellence is essential. We cannot take short cuts through 20 serum samples or faecal samples and get an overview of test results from the laboratory. You must rely on a thorough individual clinical examination. In many cases, you choose the treatment based only on the clinical diagno-sis. When you evaluate a lame animal, you must consider the circumstances. Did the sow lie down sleeping until you arrived? If so, allow her to walk a little bit before observing her. What is the flooring like? Is it slippery? Research results have shown that pigs take shorter strides on a slippery floor. Video recordings are a good way of documenting the nature of the lameness. Now that virtually everybody has a digital video camera in their pocket (in their smart phone), it is possible to exchange videos and get other people's opinion on the case. After having observed the animals from a distance, you should then try to make a close examination. In piglets and weaner pigs, this is fairly easy once they have been caught, and in these smaller pigs you can palpate the larger joints and take a close look at the claws. The large finishers and gilts are more reluctant to be examined, but when they are fixed in a sling, the lower joints of the limbs can be palpated, and you can take a quick look at the sole of the claws. Sows are usually calmer, and you can examine them in crates, stalls or in group housing. Recently, more focus has been placed on the examination of claws in sows, and you can find scoring sheets from Feet First® group (see further reading). It is useful to have a common scor-ing system when making comparisons.

Antibiotic treatment is by no means always the right treatment. It is often used because it is what we can do and it might help, but we should use antibiotics more wisely. In many cases, especially in sows, an anti-inflammatory treatment would make more sense, as they seldom have infectious arthritis. Your diagnostic work is a prerequisite for providing the best treatment and taking the right preventive measures.

Further reading

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NOTES

RISK FACTORS AND PREVENTION OF LAMENESS

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Clinical signs of lameness and neurological symptoms are very common problems in swine herds. Lameness is one of the most important causes of culling in breeding stock, but can also be observed in preweaning and postweaning pigs as well as in fattening pigs. Since lameness is always associated with pain and discomfort, which may lead to reduced productivity, it is a significant animal welfare issue as well as a major economic problem in pig production. Causes of lameness can be manifold and strongly depend on the affected organs (musculo-skeletal/neurological system) and the involved age group.

PREWEANING PIGS

The most common conditions causing locomotive disorders in preweaning pigs are skin and foot lesions, arthritis/polyarthritis and splayleg. Less frequent conditions may be congenital/hereditary abnormalities such as syndactyly, polydactyly, arthrogryposis or hyperostosis. Injections into the hind quarter muscles can result in hind leg paresis or clostridial infection.
The risk of lameness incidence is highest in the first week of life and decreases continuously until weaning (Zoric 2010).

Skin and foot lesions

Skin lesions in piglets are most commonly bilateral and can be observed most frequently as abrasions over the carpal joints. Typical foot lesions in preweaning pigs are bruising on the heels, sole erosions and injuries to the coronary band. If infection enters, it can give rise to septic arthritis of the pedal joints. The prevalence and extent of skin and foot lesions are highest in the first days of life and decline after day 10, most of the lesions disappearing until weaning. They are strongly influenced by the type and condition of flooring.
To estimate the risk factors for a given floor, the actual floor condition must be evaluated. On solid concrete floors more lesions could be observed on older concrete, when the surface was rough and eroded. Lesions could be decreased using ample bedding (straw, peat) in comparison to sparse or no bedding or repairing the concrete. Piglets kept on partly or fully slatted floors showed more lesions on round-weld mesh and flat-metal rods than on plastic slats (Moutotou et al. 1999, KilBride et al. 2009, Zoric 2010). Only few lesions appear on plastic-coated woven wire. Coronary band lesions are especially influenced by the slot width of slatted floors. They increase, if the size and shape of the slot is large compared to the piglet's foot size (Wechsler 2005). Guidelines for keeping pigs recommend maximum slot widths between 9 and 11 mm.
Another main contributing factor for skin and foot lesions is the suckling behaviour of the piglets. More and severe lesions must be expected when a sow is suf-

fering from hyo-/agalactia or the number of teats is not adequate to the litter size and more vigorous competition for the teats is present (Smith and Mitchell 1976). Piglets housed outdoors had a very low incidence of foot and limb injuries in comparison to those housed indoors (KilBride et al. 2009).

Arthritis/polyarthritis

Cases of arthritis or polyarthritis in piglets are caused by ubiquitous microbes such as Streptococcus spp, Staphylococcus spp, Escherichia coli or Arcanobacterium pyogenes (Nielsen et al. 1975, Zoric 2010). Bacteria may enter piglets via skin wounds, the navel or the tonsils, followed by haematogenous distribution. Therefore, important risk factors may be a poor hygienic level in general and with regard to zootechnical applications (castration, tail docking, teeth clipping), as well as omphalitis and hypogalactia of the sow leading to skin lesions of the piglets (abrasion, biting). Also maternal immunity may play a role, because piglets from gilts more often suffer from polyarthritis than litters of older sows (Nielsen et al. 1975).

The incidence of arthritis/polyarthrits is influenced by the type of flooring, piglets kept on partly slatted floors with some bedding and fully slatted floors showing fewer symptoms compared with those housed on solid concrete floors with bedding. Incidence was higher on rough floors compared with smooth floors (KilBride et al. 2009).

Preventive measures against skin and foot lesions as well as arthritis/polyarthritis include the optimisation of flooring conditions and hygienic status, especially for zootechnical applications (disinfection of instruments and wounds), as well as treatment and prevention of hyo-/agalaktia of sows.

Splayleg

Splayleg is an important congenital condition of piglets, which is associated with myofibrillar hypoplasia and clinical signs of paresis and immobility. Association with different risk factors has been described; however, aetiology and pathogenesis are not well understood.

Heritability is often discussed as a possible aetiology, but a German investigation based on records of 47,323 litters of 351 German Landrace boars and 1,134 Pietrain boars in the years 1982-2000 showed that the frequency of splayleg could not be lowered over this period due to selection (Beißner et al. 2003). A survey derived from a Large White-Landrace base population in Nebraska found direct and maternal heritabilities (h^2) of 0.07 and 0.16, respectively, using 37,673 records of pigs of 6 different lines (Holl and Johnson 2005).

Splayleg can be observed more frequently in males than in females and in piglets with low birthweights (Vogt et al. 1984, Holl and Johnson 2005). The likelihood of splayleg pigs was affected by traits of the dam (increasing litter size, reaching puberty at younger ages, fewer numbers of nipples, decreased embryonic survival at 50 d, inbreeding of the dam) (Holl and Johnson 2005). Gestation length may also influence the incidence of splayleg. Partus induction on day 112 led to more affected piglets in comparison to day 114 (Boelcskei et al. 1996).

Some investigators suggest that splayleg might represent a congenital form of glucocorticoid myopathy resulting from stress and hormonal imbalance of pregnant sows which affect the fetuses. Myofibrillar hypoplasia could be induced experimentally in piglets of Belgian Landrace sows by dexamethasone treatment of the sows during late pregnancy, but pathohistological lesions were observed without clinical signs. Differences to piglets with clinical signs of splayleg included the maturity of the myofibrils and the degree of autophagosomal glycogen breakdown (Jirmanová 1983, Ducatelle et al. 1986).
In splaylegged piglets the myelinisation of fibres in the lumbar spinal cord which innervate the hindlimb muscles is retarded (Szalay et al. 2001). Deficiencies of amino acids such as cholin and methionine which are essential for normal myelin production are supposed to be a cause of splayleg (Cunha 1968). However, other studies rejected this hypothesis, demonstrating that a sufficient supply of the sows´ daily ration could not prevent cases of splayleg (Dobson 1971, Iben 1989).
The occurrence of Fusarium mycotoxicosis may be accompanied by increased numbers of splayleg piglets (Alexopoulos 2001).
Type and slipperiness of the floor is discussed as another risk factor for splayleg (Christison et al. 1987), but this could not be confirmed by other studies (Van der Heyde et al. 1989).
To avoid the occurrence of immature myelinisation and myofibrils early parturition should be prevented (adequate partus induction, application of altrenogest (day 111-113), PRRS vaccination).

WEANED AND GROWING PIGS, BREEDING SOWS

Causes for lameness in weaned and growing pigs as well as in breeding sows are shown in table 1. While listed viral infections are fortunately rare events, frequent cases of locomotive disorder in younger pigs (weaner pigs, grower pigs, gilts) can be seen with emphasis on different bacterial infections causing polyarthritis and other symptoms (S. suis, H. parasuis, M. hyorhinis, M. hyosynoviae, E. rhusiopathiae). The most important risk factor is an insufficient herd immunity. Introduction of healthy carrier pigs of virulent strains into a naïve herd or mixing pigs of herds with different immune status may result in a disease course with devastating economic losses. New breeding stock from a herd with a different health background must be isolated for an acclimatisation period long enough to allow the development of protective immunity from either vaccination or natural exposure. Piglets should have the opportunity for a sufficient intake of colostral antibodies during the first 24-36 hours.
Many pigs harbour virulent strains of bacteria causing polyarthritis in the upper respiratory tract without clinical disease, but stress factors (overcrowding, poor ventilation, excessive temperature fluctuations, mixing of piglets with more than a 2-week age difference, inadequate trough spaces or water availability) may trigger a clinical outbreak (Dee et al. 1993). Management practices such as all-in/all-out pig flow, dividing large buildings into smaller rooms as well as cleaning

and disinfecting rooms between groups of pigs can help reduce the incidence of diseases. The use of MEW and SEW practices is questionable in the case of early colonizers, such as S. suis and H. parasuis. Controlled exposure of young piglets to a low dose of the prevalent strains while pigs are still protected by maternal antibodies has been proposed as an alternative technique to control these bacteria (Oliveira et al. 2004).
Successful disease control is frequently reported by vaccination with commercial or autogenous bacterins. Failure of vaccination may be due to lack of cross-protection for the strain/serovar, the presence of more than one strain/serovar or the introduction of a new strain/serovar into the herd. Isolates recovered from new clinical cases should be genotyped and compared with those in the vaccine (Oliveira et al. 2004). Timing and management of vaccination must be appropriate.
Purulent arthritis/polyarthritis by streptococci, staphlycocci or Arcanobacterium pyogenes can be seen less frequently than in suckling pigs. Clinical cases of brucellosis or tuberculosis may occasionally appear as diskospondylitis associated with posterior paralysis or arthritis at any age in pigs.

Tab.1 Diseases with lameness/paresis in weaned pigs, growing pigs and breeding sows

Infectious	**Non-infectious**
Viral	**Metabolic**
foot-and-mouth disease	rickets, osteomalacia
swine vesicular disease	muscle dystrophy (vitamin E/selenium deficiency)
vesicular exanthema	
vesicular stomatitis	
Teschovirus infection	
Bacterial	**Toxic**
Streptococcus suis	selenium toxicosis, vitamin D toxicosis,
Haemophilus parasuis	vitamin A toxicosis, organophosphate toxicosis
Mycoplasma hyorhinis	laminitis
Mycoplasma hyosynoviae	**Degenerative**
Erysipelothrix rhusiopathiae	osteochondrosis, epiphyseolysis, apophyseolysis
other Strep. spp., Staph. spp.,	**Traumatic/Physical injuries**
Arcanobacterium pyogenes	fracture, sprains, dislocations
Brucella suis	muscle bruising, strains
Mycobacterium tuberculosis	adventitious bursitis
Clostridium tetani	claw lesions
Clostridium septicum	**Hereditary / Congenital**
	back muscle necrosis

Non-infectious causes of lameness include nutritional deficiencies and toxicities. With modern dietary formulations actual deficiencies (Ca, P, vitamin D, vitamin E, selenium) arising due to defective diet would be unusual. Problems however occur due to faulty storage, incorrect application of the feed or interactions which reduce the availability to the pig. In comparison to Ca or vitamin D deficiencies phosphorus deficiencies may occur more frequently, because there are a lot of factors affecting the P digestibility (the origin of feedstuff, the concentration of phytate and of the total P and the presence of phytase). Toxicities mainly result from mixing errors in feed production (selenium, vitamin D, vitamin A) or feed contamination on the farm (organophosphates).
As the most frequent non-infectious causes of lameness osteochondrosis and claw lesions are observed in growing and breeding pigs and therefore should be discussed in more detail.

Osteochondrosis
While primary changes of osteochondrosis in pigs are commonly seen at an age of 2 months clinical signs of lameness are normally not evident at this age. Locomotive disorders due to osteochondrosis are mostly not observed until 4 months of age and pigs up to 18 months may be affected. Osteochondrosis is characterised by a disturbance in the enchondral ossification; the lesions can develop both in the articular–epiphyseal cartilage complex and the physeal growth cartilage. The viability of epiphyseal cartilage is highly dependent on an adequate blood supply from cartilage canal vessels. Necrosis of cartilage canal vessels leads to necrosis of epiphyseal cartilage as the initial morphologic event in osteochondrosis. Typical lesions of osteochondrosis are not generalised, but focal in nature. However, osteochondrosis may occur in multifocal locations in the same individual animal, with lesions often being bilaterally symmetrical (Calson et al. 1991, Ytrehus et al. 2007).
For the course of osteochondrosis three stages are described. The presence of a focal area of cartilage necrosis which is confined to the epiphyseal cartilage is called osteochondrosis latens, whereas the presence of a focal failure of enchondral ossification which is already visible on macroscopic and radiographic examination is designated as osteochondrosis manifesta. If a fissure forms in the area of necrotic cartilage and extends through the articular cartilage, the lesion is termed osteochondrosis dissecans (Ytrehus et al. 2004).

There are several factors which may contribute to the development of osteochondrosis:
- **Rapid growth:** Due to economic pressure the growth rate of pigs from birth to slaughter has continuously increased in the last decades and it is a frequently mentioned hypothesis that a rapid growth due to increased feeding or heritable traits supports the development of osteochondrosis. On the other hand, investigators failed to find a correlation between growth rate and typical lesions of osteochondrosis when lowering the feed intake or testing pigs with a genetically lower growth rate (Carlson et al. 1988, Uhlhorn et al. 1995). Therefore, it

could be necessary to evaluate the growth rate not only from birth to slaughter, but at different times. Lundeheim (1987) found that pigs with clinical signs of osteochondrosis at slaughter had shown high weight gains early in life, but had grown more slowly closer to slaughter due to discomfort and pain after developing severe osteochondral lesions.

- **Hereditary:** Differences in the prevalence of osteochondrosis between different breeds and breeding lines indicate a heritable component, but estimates for the heritability vary greatly. Anatomic characteristics may play a role as a potential hereditary factor. It can be suggested that an unfavourable joint shape creating local overload is an important cause of osteochondrosis. Carcass length and relative weight of hams were other traits correlated to osteochondrosis lesions (Grøndalen 1974, van der Wal et al. 1980).

Several quantitative trait loci (QTL) for osteochondrosis exceeding a stringent significance threshold have been described recently on different chromosomes (Anderson-Eklund et al. 2000, Christensen et al. 2010, Uemoto et al. 2010, Laenoi et al. 2011). A database has been developed called PigQTLdb where QTL are collected to help researchers to share published data. Kardamideen et Janss (2005) found significant evidence that osteochondrosis is not only under a polygenic mode of inheritance but also affected by a major gene, which may provide an opportunity to select against this disease.

Most studies have focused on the late stages of the disease (osteochondrosis manifesta and dissecans). The results may be different if early lesions could be included, since these are less likely to be influenced by factors involved in the long-term progression of the disease (Ytrehus et al. 2007).

Matrix gamma-carboxyglutamate (Gla)-protein (MGP) is a potential calcification inhibitor of extracellular matrix and might contribute to the development of osteochondrosis. Downregulation of MGP was found in osteochondrosis diseased pigs in comparison to healthy ones, which makes the MGP gene a candidate gene for the development of the disease (Laenoi et al. 2010).

- **Trauma:** The role of trauma as a risk factor for osteochondrosis may depend on the stage of the disease. Major trauma is suspected to play a role in the progression of lesions of osteochondrosis manifesta to lesions of osteochondrosis dissecans, while microtrauma affecting the cartilage canal blood vessels at the chondro-osseous junction at a certain age window?? may be an initiating event in the formation of lesions (Ytrehus et al. 2007).

- **Dietary factors:** Several studies investigating the role of mineral (Ca, P) and vitamin (A, C, D) deficiencies as a risk factor for osteochondrosis failed to find strong evidence of an association (Reiland 1978, Nakano et al. 1983, Reiland et al. 1991). On the other hand, feeding diets containing ingredients involved in cartilage and bone metabolism (Cu, Mn, Si, methionine, threonine, proline, glycine) reduced the severity of osteochondrosis lesions. Nonetheless, it remained unclear whether ingredients may prevent formation of new lesions or cause regression of existing lesions (Frantz et al. 2008).

Selection against osteochondrosis seems to be the most important recommendation for prevention in the future. Only limited success can be expected from reducing the growth rate, improving the housing conditions to prevent trauma or optimising the feed composition.

Claw lesions

Older growing pigs and adults mainly experience lameness caused by injuries, especially to the claws. The lesions may be limited to the foot or may permit entry of infections which spread upwards to affect one or more joints. Studies in sow herds showed a high prevalence of claw lesions. More than 96% of slaughtered loose-housed sows and 80% of slaughtered confined sows had at least 1 lesion on the lateral hind claws (Gjein and Larssen 1995). Rear outer claws had the greatest number of lesions associated with lameness in sows, several lesions being related to sow parity (Bradley et al. 2007). Sows housed in pens with electronic sow feeders were more likely than stall-housed sows to have all types of lesions in any claw (Anil et al. 2007).

- Physiologically medial digits are slightly smaller than lateral digits. Strong discrepancies in size (hypoplasia of the medial digit) may lead to overloading of the lateral claw followed by foot lesions or overgrowth of the heel. Genetic influences are discussed for the occurrence of the hypoplasia; affected breeding pigs should be selected.
- Overgrowth of the claws and dewclaws is associated with housing pigs on muddy ground or on very deep litter. Insufficient exercise may be another risk factor, if pigs are kept in small overcrowded pens, single crates or on slippery floors (wet floor, plastic slats). A change in weight bearing due to a painful condition may result in single overgrown claws. Secondary to overgrowth, an overloading of the heel as well as heel erosions and injuries of the main and accessory claws can be observed. Sufficient exercise and treatment of the floor surface for slip resistance can help to avoid overgrowth.
- Lesions of the coronary band may develop if the gap width of slatted floors is inadequate,.or sharp edges or steps are present in the environment. Secondary bacterial invasion leads to phlegmonous inflammation and ulceration of the coronet (bush-foot) and can reach the deep digital flexor tendon or the phalangeal bones or joints (foot-rot). Other lesions of the claws (erosions of the sole and heel, wall cracks, fissures at the white line) may also provide points of entry for bacterial infections followed by the development of foot-rot.
- Vertical and horizontal wall cracks, white line cracks, cracks between sole and heel as well as heel and wall are associated with painful lameness if the corium is irritated or infected. Predisposed areas for cracks are borders where soft horn (heel) and harder horn (sole, wall) converge. Risk factors for development are sub-flooring conditions (rough surface, broken slats, gaps too wide), frequent rotations/sudden movements, i.e. during grouping and rank order fights of sows, overgrown claws and insufficient horn quality (influence of feeding and floor conditions (wet, muddy surfaces, deep, moist litter leading to softer horn)).
- Sole and heel erosions may result from keeping pigs on hard, abrasive floors or from chemical effects of newly laid concrete. Lameness can be observed, if co-

rium defects or pododermatitis are present. Abrasion is promoted by insufficient horn quality (see above).

Preventative measurements to protect pigs from claw lesions are related to different subjects:

- **Zootechnical intervention:** Checking claws regularly and trimming overgrown hooves in early stages prevent painful injuries and lameness.
- **Floor conditions:** The floor surface must be slip-resistant and moderate abrasion must be guaranteed to avoid overgrowth. Severe abrasive floors must be re-laid, painted with resin or rubber paint, or rubber mats can be used temporarily to prevent sole and heel erosions. Newly laid concrete should be treated with sodium carbonate before first animal contact. To avoid wet floors the slope of the floor must be sufficient to let fluids run off. Slats must have pencil edges and there should be no level differences, slat and gap width must be age-related. Steps in the moving area?? should be replaced by raked floors. Slatted floor show a higher risk for lameness in sows than solid floors (Heinonen et al. 2006).
- **Hygiene:** Since floors have to be dry and clean to prevent negative influences on horn quality and slippery surfaces, faeces, urine, as well as deep muddy litter have to be removed regularly; proportion of gaps of slatted floors must be sufficient to let the faeces fall through.
- **Stall climate:** Stall climate control (temperature, humidity, ventilation) is additionally helpful to avoid wet, slppery, cold floors.
- **Housing management:** Minimisation of rank order fights with fast movements and tunings in group-housed sows may decrease the risk of claw lesions (Anil et al. 2006).Therefore, special pens for grouping sows should be used (3-6 m²/sow, one or two days, concrete with straw litter). The best time for grouping is directly after weaning or 5 weeks after mating. To maintain stable sub-groups in the group housing area the structure of pens and resting areas must be adapted to the number of sows per group. Providing manipulable material is also helpful in minimising stress situations.
- **Feeding:** Fighting can be decreased by providing individual, undisturbed feed intake. Feed ingredients may influence the quality of the horn. Sulphur containing amino acids (methionine/cystin; recommendation: 3.6 g/kg feed for gestating sows, 5.6 g/kg feed for lactating sows) is important for the production of keratins. Biotin supplementation has a postive effect on claw integrity (recommendation: 0.2 (up to 2.0) mg/kg feed), because biotin is involved in the formation of the intercellular cementing substance (ICS). ICS plays an important role in the regulation of hydratisation of the horn. Biotin deficiency may lead to brittle horn quality. Important micronutrients which can have an influence on horn quality, are zinc, copper and manganese (recommendations: 50 mg/kg, 8-10 mg/kg and 20-25 mg/kg feed, respectively) (Mülling et al. 1999, Tomlinson et al. 2004, Ausschuss für Bedarfsnormen 2006)
- **Genetic selection:** Selection based on traits such as good skeletal conformation and feet and leg soundness is necessary to improve claw health in herds

(Fan et al. 2009). Selection based on docility may prevent traumata caused by frequent fighting.

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NOTES

WHAT DO WE KNOW ABOUT TAIL BITING TODAY?

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The extent of the problem

Tail biting has proved to be an intractable problem in the pig industry worldwide. Despite this, we have little knowledge of the true extent of the problem and its cost to the industry. In countries where there is routine abattoir registration of bitten tails, reported prevalence ranges from 0.5-3.4% (EFSA 2007). However, it is clear from specific studies that these values underestimate the number of pigs which have received tail biting, and represent only the more severe cases. In both Sweden (Keeling and Larsen, 2004) and the UK (Hunter et al., 1999) detailed study revealed a prevalence of lesions 2-4 times that recorded in abattoir records. Boyle et al. (2010) recently found that 6.3% of Irish slaughter pigs had tail damage that could conclusively be attributed to tail biting, with many more showing less severe damage that might also have arisen from this problem . Furthermore, it is obvious that abattoir records will underestimate the full extent of the problem, since severely bitten pigs are likely to die or be euthanized on farm, or be disposed of as casualties through smaller, unrecorded abattoirs. There are few large scale studies of on-farm prevalence and, since these often involve volunteer farms, they cannot be said to represent an unbiased sample. A UK national health surveillance programme routinely reports prevalence fluctuating around 0.9% (NADIS, 2011). However, this again may underestimate the true extent of the problem, since a recent detailed study of 69 UK farms reported 3.5% of bittern pigs, with approximately 3 mildly bitten tails for every severe clinical case (Taylor et al., 2011). Similarly, recent Belgian studies have reported a tail lesion prevalence of 2-4% (Smulders et al., 2008; Goossens et al., 2008), despite the majority of pigs being docked. Taylor et al. (2010) have emphasised the importance of standardising the criterion for recording a bitten tail, and highlight the concern that projects may produce results that are not directly comparable unless clear criteria are provided for how lesions were assessed. Mullan et al. (2009) also highlighted the fact that a farm score for dirtiness of pigs has a significant negative correlation with recorded tail lesions. They recommended that, to prevent bias in the recording of tail lesions, assessments are conducted on pigs with a prevalence for dirtiness of less than 17%.

Which pigs are involved?

Since tail bitten pigs are readily apparent and easy to record, they have been the focus of most studies on tail biting and there are many data sets documenting the characteristics of these pigs. It is commonly found that tail lesions are more prevalent amongst male pigs (see review in EFSA, 2007), and some suggestions of breed differences have been made, with Hampshire pigs having fewest lesions in mixed breed pens (L Keeling, cited in EFSA 2007). This has lead to the suggestion that there may be animals which are predisposed to be victims. In a detailed study of the longitudinal progression of tail biting outbreaks, Zonderland (2010) observed that some piglets were already receiving more bites than their penmates six days before a clinical outbreak occurred. However, once the outbreak started, these pigs did not experience a greater increase in bites than other members of pen, indicating that all pigs could become victims. These early victims were more often male and were heavier pigs in the group, a finding also reported in other studies. It is suggested that these heavier pigs are less active, and receive tail chewing with little response whilst resting, or that they are more dominant and therefore likely to receive aggression from behind when subordinate pigs try to displace them from resources.

A more important question, and one still little studied, is the characteristics of the pigs which actually perform the biting. This requires detailed observation of the group, particularly at the onset of an outbreak, and is thus very time demanding. Older studies suggested that there might be breed differences in predisposition to bite, and this is supported by more recent data (Breuer et al., 2005; L Keeling, cited in EFSA 2007). Both studies reported greater prevalence of tail biting behaviour in Landrace pigs than in Large White/Yorkshire, with the latter study also reporting lower prevalence in Hampshire pigs. Such reports suggest the possibility of a genetic component to tail biting predisposition. In the only study of this to date, Breuer et al. (2005) found a significant heritability of 0.27 for predisposition to tail bite in Landrace pigs, although failed to find a similar result in a smaller sample of Large White animals. The predisposition to tail bite was significantly positively genetically correlated to lean tissue growth rate, and negatively genetically correlated to backfat thickness. These data suggest the possibility of a metabolic basis to tail biting behaviour. At the individual level, growing pigs performing persistent tail biting behaviour, labelled 'fanatical biters' by van de Weerd et al. (2005), were significantly lighter than their penmates as a result of slower growth after weaning. Similarly, Beattie et al (2005) reported that weaned piglets showing a higher prevalence of tail chewing behaviour had experienced reduced growth during the suckling period. These data support the frequently reported anecdotal view that 'runt' pigs are often responsible for tail biting outbreaks. Such data might suggest some metabolic deficiency increasing either general or specific hunger for nutrients in these individuals, increasing foraging activity and making them more likely to chew and bite tails. Zonderland (2010) observed that, prior to a tail biting outbreak, biters not only directed more biting behaviour to their penmates' tails, but also to the enrichment device present in the pen, supporting the presence of increased foraging motivation. Early studies suggested that tail biting pigs might have a specific attraction to blood. Significant differences were observed between pigs in their motivation to chew a blood soaked artificial tail, and this motivation could be increased by specific nutrient deficiencies in minerals or protein (Fraser, 1987; Fraser et al., 1991). Subsequently, McIntyre and Edwards (2002a) demonstrated that pigs which exhibited clinical tail biting showed increased chewing of a blood soaked artificial tail in comparison with non-biting penmates, indicating a particular attraction to some component of blood. Edwards (2006) suggested that tail biting might be associated with metabolically induced neuroendocrine changes, with possible implication of serotonin mediated pathways controlling foraging behaviour. McIntyre and Edwards (2002b) demonstrated that pigs fed diets formulated to reduce availability of tryptophan for serotonin synthesis showed reduced resting and increased foraging behaviour, and that they also showed increased chewing of the blood soaked model in the artificial tail test. More recently, Martinez-Trejo et al. (2009) compared four levels of dietary tryptophan in piglets weaned at 21 days of age and also reported that biting of ears and tail was reduced with the two higher levels.

However, not all studies are consistent in their characterisation of tail biting pigs. In the study of van de Weerd et al. (2005) tail biters in general were not lighter than the group, and no weight difference between biters and non-biting pigs was seen in the study of Zonderland (2010). Furthermore, in this latter study, biters showed an exponential increase in tail directed behaviour over the six days preceding a clinical tail biting outbreak, even in the absence of blood over this period. These apparent inconsistencies might be explained by the recent theory of Taylor et al. (2010) that tail biting can arise from several different motivational states.

Causes of tail biting

Taylor et al. (2010) suggested three distinctly different types of tail biting, based on observations of the situation in which the behaviour occurs and the way in which it is carried out. The first, and possibly most common, is “two-stage” biting. This fits the classical description in many studies of a pre-damage stage, in which gentle non-injurious chewing of the tail occurs, often when pigs are resting, which is then followed by followed by a damaging stage when biting is more forceful, blood is present from wounded tails and the behaviour escalates within the group. This type of tail biting is thought to originate from frustrated foraging motivation, where the amount and type of environmental enrichment present in the pen is inadequate to satisfy the level of foraging and exploratory behaviour induced by the metabolic state of the pigs. Such behaviour is then redirected to penmates and, if performed at a high level, ultimately triggers tail biting. A very different type of tail biting behaviour, designated as “sudden- forceful”, has been reported in other studies (e.g. Statham, 2008). In this type, a tail is suddenly seized and yanked or bitten forcefully with no prior manipulation, often causing immediate serious injury. In contrast to two-stage biting, this behaviour is more often seen when pigs are moving around and in competition for resources such as feeders or preferred pen locations. It is suggested that it arises from aggressive motivation due to thwarting of access to a desired resource. The third type of tail biting, designated as “obsessive”, is characterised by one or more clearly identifiable individuals who persistently seek out tails and bite them forcefully over extended periods of time (e.g. van de Weerd et al., 2005). The relationship between pigs fitting this description and the other two types of tail biting is unclear. It is possible that these pigs trigger the transition between the pre-damage and damaging stages of two-stage biting, or that they develop the behaviour as a consequence of previous reinforcement of sudden-forceful biting. However, the single-minded fixation on this behaviour which is observed appears pathological rather then functional. Given the possibility of these different motivational bases for tail biting, it is easy to see why the behaviour appears to occur in response to a diverse range of situations on farm.

Risk factors for tail biting

All reviews on the subject of tail biting highlight the complexity of the problem and the multifactorial nature of apparent predisposing circumstances (Schrøder-Petersen and Simonsen, 2001; Bracke et al., 2004; EFSA, 2007; Taylor et al., 2010). In addition to risk factors intrinsic to the individual animal, as discussed above, a wide range of environmental risk factors have been identified. The most common of these relates to a lack of adequate environmental enrichment, and it has been repeatedly demonstrated that pigs in straw-bedded pens have a lower prevalence of tail biting that those in unbedded, slatted pens. This contrast is particularly marked if pigs have previously been housed on straw, but subsequently had straw withdrawn (Day et al., 2002). Chopped straw in growing/finishing housing systems is better than no enrichment, but is less good than long straw because of increased risk of penmate directed behaviours (Day et al., 2008). Whilst a small daily amount of recreational straw can be quite effective in reducing risk, many of the simple toys currently supplied in slatted housing appear relatively ineffective. For example, Zonderland (2010) compared provision of enrichment to weaned piglets, with intact tails, in the form of a chain, rubber hose, straw rack (5 g/pig/day) or the provision of straw on the floor twice daily by hand (2 x 10 g/pig/day). The incidence of pens with tail lesions was reduced when straw was provided twice daily (8% of pens) compared to the chain (58%), rubber hose (54%) and straw rack treatment (29%). A lack of enrichment leads to increased investigatory behaviour redirected towards penmates, and the classic situation for two-stage biting to occur. A second major category of risk factors relate to dietary inadequacy. Dietary deficiencies in protein, specific amino acids, minerals and energy density have all been implicated in outbreaks. Such deficiencies lead to increased foraging motivation as pigs seek to alleviate general hunger of a hunger for specific nutrients. This again provides the circumstances for two-stage biting to be initiated.

A third category of risk factor relates to deficiency in resource provision, in particular in relation to floor space (high stocking density), feeder space or drinker availability. Such deficiencies are likely to generate circumstances where “sudden-forceful” biting will occur, even when the level of enrichment in the pen is adequate, as less dominant pigs attempt to displace other animals from an occupied resource. It is possible that such behaviour may also have a developmental or learned component. Smulders et al. (2008) found that the risk for tail and ear biting lesions during fattening was negatively correlated to the amount of feeding places per animal in the nursery, A fourth major category of risk factors relate to climatic inadequacy. In this category can be listed excessive heat or cold, the presence of high airspeed within the pen and poor air quality in terms of dust or noxious gases. For example, Courboulay et al. (2008) showed that provision of a water misting system reduced tail biting in hot conditions in comparison with an otherwise similar control room, whilst the farm study of Taylor et al. (2011) found draughts in the lying area to be a prominent risk factor. It has been suggested that such environmental stressors might have metabolic consequences which trigger tail biting, in particular through increased sodium clearance causing a specific nutrient hunger that increases attraction to blood or foraging motivation, leading to two-stage biting (Fraser, 1987). However, experimental investigation of this hypothesis in pigs has failed to provide supporting evidence (Jankevicius and Widowski, 2004). It is perhaps more likely that environmental inadequacy increases competition for the less aversive areas of the pen, and hence greater risk of sudden-forceful biting events.

The final major risk category, and one now gathering increasing evidence of importance, is pig health. It is frequently reported that herds with a poorer health status, or herds experiencing a recent health breakdown, have a higher prevalence of tail biting. Both respiratory (Elst et al., 1998; Moinard et al., 1993) and enteric health conditions have been linked to the problem. There have been several reports that specific measures to control health problems have been associated with reduced tail biting, for example anthelminthic treatment (Barnikol, 1978), Lawsonia vaccination (Almond & Bilkei, 2006), and most recently PCV2 vaccination (Parker et al., 2011). Disease challenge changes nutrient partitioning and specific amino acid requirements as an immune response is activated, and may thus influence metabolic drivers for two-stage biting. The previous growth check reported for obsessive biters, suggests that earlier disease may sometimes have played a role in their pathogenesis.

Prevention of tail biting

Given the current scientific level of knowledge on the risk factors for tail biting, it is perhaps surprising that the problem remains so common on farms. To investigate the reasons for this, and to develop farm specific approaches to reduce risk, Taylor et al. (2011) developed a Husbandry Advisory Tool (HAT) for tail biting prevention. This spreadsheet tool incorporates questions on 83 risk factors, weighted for their relative impact on tail biting according to information from scientific literature and expert consultation. High weighting is given to factors strongly linked to tail biting (e.g. tail biting already occurring in the current batch of pigs: risk score 90; current illness in the batch: risk score 80), and low weighting is given to factors whose impact on tail biting is less clear (e.g. specific qualities of toys when provided for enrichment: risk score 2.5). The HAT used in this study, together with supporting evidence from the scientific literature for the strength of risk association, is available at http://www.vetschool.bris.ac.uk/webhat/ . The presence of each of these risks was scored on 65 farms which received 2-4 visits over a 12 month period. There was significant variation between farms in total risk, with weighted scores ranging from 255 up to 805. The HAT-derived risk score was a very significant predictor of tail biting in a pen across the study farms. Farms with high risk scores in all the major categories were reported; 'atmosphere and environment' (mean risk score 24% of a maximum possible score of 500), 'enrichment' (mean score 21% of maximum 430), 'feed and drink' (mean score 17% of maximum 345), and 'health' (mean score 10% of maximum 200). It is therefore apparent that, although knowledge of risk factors exists, these are frequently not avoided under practical farm conditions, either through lack of available capital, time or awareness. There is significant potential for use of the HAT approach to highlight risk areas and motivate farm improvement.

Managing tail biting outbreaks

Once a clinical tail biting outbreak has begun, the presence of blood seems to stimulate biting activity in other pigs and rapidly escalate the problem. Niemi et al. (2010) showed that tail biting spreads with epidemic-like features within the farm. The probability of further tail biting incidences in a pen after the first case has been reported is approximately 0.55. In addition, as more pens are affected, the total incidence of tail biting increases exponentially. It is therefore very important to stop the tail biting at an early stage. Recent longitudinal studies of groups of pigs prior to, and during outbreaks have sought to identify predictive signs. Zonderland (2010) highlighted the fact that tail posture in undocked pigs could predict clinical tail biting 2-3 days in advance. Other behavioural signs in the six days preceding an outbreak were increased non-damaging tail manipulation by subsequent biters and increased restlessness in the group from recipients of this manipulation. Statham et al. (2009) also found, in older pigs, that measurement of activity has potential for predicting tail biting outbreaks on commercial farms, as do levels of tails tucked under and damaging tail contact. In five cases, a small runty pig was tail bitten in the absence of a full outbreak. Whenever this happened, a full tail-biting outbreak always took place sometime afterwards. The occurrence of single tail-biting events may thus be a reliable indicator of future outbreaks. However, they concluded that tail biting outbreaks are variable and difficult to predict from single measures.

Zonderland (2010) compared two curative treatments once an outbreak had started in weaned piglets - removal of the biter and twice daily straw provision. No significant difference was found between the treatments, both of which showed a reduced incidence of fresh blood on the tails in the following nine days. However, it was not considered ethically acceptable to impose a negative control treatment and neither curative treatment eliminated tail biting entirely. There is a lack of controlled studies on other curative measures such as unpalatable sprays, salt provision or the use of specially designed nutritional supplements. This is an area where further research is needed, as current commercial experience suggests that outbreaks, once established, are very difficult to contain.

The future role of tail docking

In 1991, EU Legislation came into force which specified that tail docking should not be carried out routinely, but should only take place when other measures proved to be ineffective in controlling tail biting (Directive 91/630). Despite the passage of 10 years, the majority of pigs in the EU are still tail docked, although some Scandanavian countries have imposed a unilateral ban on this practice. Political and consumer pressure to reduce and eventually abolish tail docking is growing, but the likely consequences of an EU-wide banare difficult to estimate. Countries which have a ban in place appear to have an abattoir prevalence of bitten pigs which is 3-4 times higher than that in countries where most pigs are docked (EFSA, 2007). However, it is uncertain whether lesions are recorded according to the same criteria, and it must be borne in mind that these countries also require straw to be provided for all pigs. Where comparisons of docked and undocked pigs at the same abattoir have been made, prevalence of tail lesions has again been about 3 times greater in the undocked pigs (Hunter et al., 1999, 2001), but it must be remembered that leaving tails intact is the choice of the farmer, and likely to reflect a low risk situation. This can sometimes give apparently contradictory results, as in the study of Moinard et al. (2003) where tail biting was more often reported on farms that docked tails than on those that did not. There are relatively few controlled studies which have examined the effects of docked and entire tails under the same conditions. However, three comparative studies in unbedded systems have shown an increase in prevalence of bitten pigs from <10% in docked animals to >50% in those left with entire tails. The most recent study, replicated across four different farms in Denmark, showed a progressive increase in tail biting prevalence related to the length of tail remaining after docking (Thodberg et al., 2010). Log odds-ratio for tail biting in pigs docked leaving 5.7 cm, 7.5 cm and intact tails were 2.8, 3.3 and 4.6 compared to pigs short-docked to a 2.9 cm tail. Therefore, whilst some farms are currently able to operate with entire tails and little damage, present information suggests that many EU farms would experience significant problems if they ceased docking without first implementing changes in housing and management. However, both the legal and ethical impetus requires that the industry moves progressively towards this outcome.

Conclusions

Tail biting remains an intractable problem for the pig industry because, despite increasing scientific knowledge, its multifactorial predisposing factors are still widespread in commercial practice. The industry should strive for a situation where widespread tail docking is unnecessary as a precautionary measure, but this poses great challenges for the majority of units, especially where pigs are housed in slatted systems. Genetic selection strategies, good health management and improved environmental enrichment provision are all likely to be key factors in future progress.

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NOTES

THE CONSEQUENCE OF A TAIL BITING OUTBREAK

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Tail-biting is a behavioural abnormality of growing pigs with considerable impact on animal welfare as well as economic measures. Certain factors seem clearly associated with being tail bitten, but research designed to reveal causalities is scarce.

Tail biting causes more tail biting
Tail biting is known to spread readily between pens with visual contact (Blackshaw, 1981). The development of an outbreak was modelled by Sinisalo and Niemi (2010) based on data from one Finnish farm. The risk of a new case (visibly bitten tail) in a pen was found to increase and the time between new cases to decrease as the number of bitten tails in the pen increased. A farm-level simulation model predicted that the number of pens with tail biting increases slowly until the prevalence is about 40% (of pens), whereafter the number of cases will increase rapidly (Sinisalo and Niemi, 2010).

Growth and feed conversion ratio
Wallgren and Lindahl (1986) reported that being tail bitten decreased growth in fattening pigs. The same was documented by Sinisalo and Niemi (2010), who showed that the effect at least partly was due to an increased feed conversion ratio.

Spreading of infection from the tail
Tail lesions attributable to biting have repeatedly been associated with condemnations at slaughter, especially those due to arthritis or abscesses in the vertebral column or lungs (Huey 1996, Valros et al., 2004, Kritas and Morrison 2007). Biting wounds on the tail easily become infected. The infection has been hypothesised to potentially spread in the body through one of several routes including blood and lymphatic vessels and other tail tissues (Hagen and Skulberg, 1960; Elbers et al., 1992; Huey, 1996). These studies include only slaughterhouse data, that is, only market-weight pigs leaving many healed and all culled victims out. Health in relation to tail biting behaviour was investigated on a problem farm by matching bitten pigs, biters and controls between 23 and 83 kg (Munsterhjelm et al., unpublished data). In this data several measures indicated that the health status of the victims was worse than that of the controls and tail biters. The victims had histologically more severe tail and respiratory infections as well as higher serum protein concentration and white blood cell counts (numerically), which may be a reflection of challenge of the body by infections. A drawback of the study design is that causalities cannot be determined, thus, the differences may have been present before the animals were bitten.

Culling and death

The risk of being culled is substantially increased in tail biting victims (Sinisalo and Niemi, 2010). Deaths may also be more frequent in victims than non-victims (Sambraus, 1985, Fraser and Broom 1997), although successful on-farm treatment strategies may remove the effect (Sinisalo and Niemi, 2010).

Stress

Being subjected to tail biting behaviour seems to be associated with chronic stress (Munsterhjelm et al., unpublished). Pain and infection are certainly stressful. Additionally, psychological effects of being bitten probably add to the state. Tail biting victims in the case-control study by Munsterhjelm et al., (unpublished) had depressed levels of the thyroid hormone T3 as compared to the controls. These animals may have suffered from a triad of interrelated hypothyroidism, chronic stress and infections (Nicoloff et al., 1970, Bianco et al., 1978). Again, causalities and their directions are unknown.

Animal welfare

Freedom from disease and distress are assigned high priority when assessing animal welfare (e.g. Duncan and Fraser, 1997). Both conditions are frequent in tail biting outbreaks, during which both biters and victims may be affected. Stress and decreased professional satisfaction experienced by the caretaker during outbreaks should be noted as well, as the human factor is decisive for the welfare of animals.

Economic losses

Decreased growth, treatment of sick animals, deaths and measures to control the problem cause economic losses (although measures taken to decrease tail biting may increase overall health in the herd). According to a simulation model by Sinisalo and Niemi (2010) losses per animal increase with prevalence on the farm. The increase is slow up to a prevalence of 50% of pens, when losses are estimated to 4,8 € per pig. Thereafter the curve takes a steeper incline to reach more than 20 € per pig when the prevalence is 80%.

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NOTES

FACTORS AFFECTING MILK PRODUCTION AND MAMMARY DEVELOPMENT IN SWINE

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Sow milk yield is a crucial determinant of piglet growth rate as it is the only source of energy for suckling piglets. It is influenced by numerous factors such as litter size, parity, nutrition, genetics, management, environment and endocrine status. Yet, one factor of importance which is often overlooked is mammary development. Indeed, sow milk yield is dependent on the number of milk-producing cells present in mammary glands at the onset of lactation (Head and Williams cited by Pluske et al., 1995). It was shown that there is a positive correlation between the DNA content (indicative of cell number) of mammary glands and piglet growth rate (Nielsen et al., 2001). Periods with relatively high mammary growth are of particular interest since it is during those periods that mammary growth may be susceptible to nutritional or hormonal manipulations. Mammogenesis in swine occurs at two developmental stages, namely, in prepubertal gilts as of 3 months of age, and during the last third of pregnancy (Sørensen et al., 2002). It is controlled by a complex interaction of various hormones. During gestation, estrogens (Kensinger et al., 1986) and prolactin (Farmer et al., 2000) are known to be essential for mammary development and relaxin (Hurley et al., 1991) is also needed to stimulate total mammary gland growth.

Very few studies have looked at the effect of endocrine manipulations on mammogenesis. Gilts receiving injections of porcine prolactin for a period of 28 days, as of 75 kg BW, had an increased mammary development which was characterized by distended alveolar and ductal lumina and the presence of secretory materials (McLaughlin et al., 1997). Interestingly, the degree of mammary gland development did not appear to be related to the dose of prolactin injected. A further study demonstrated that injections of porcine prolactin to gilts for a period of 29 days, starting at 75 kg BW, stimulate mammary development and alter expression of prolactin-related genes at puberty (Farmer et al., 2005). Yet, the impact of such a treatment on subsequent milk yield is not known.

Nutrition does have an influence on mammogenesis, yet, data on the effect of nutrition on mammary development in swine are sparse. Results on the effects of feeding level during prepuberty on mammogenesis in gilts are somewhat controversial. Sørensen et al. (1998) and Le Cozler et al. (1998, 1999) reported that feeding level of gilts during the period from 6 or 10 weeks of age to mating did not affect subsequent milk yield. On the other hand, Kirchgessner et al. (1984) fed gilts either ad lib or restricted from weaning to mating and found that piglets from sows which were restricted-fed had the highest growth rate in parity 2 (but not in parity 1 and 3). Nevertheless, when looking specifically at mammary development, feeding level does have an effect since Farmer et al. (2004) reported that a 20% feed restriction of gilts from 90 days of age until puberty drastically reduced mammary parenchymal tissue mass. Furthermore, Sørensen et al. (2006) noted that high feeding levels (ad libitum vs. restricted feeding) from 90 days of age to puberty stimulates mammary development. On the other hand, lowering protein intake during that same period does not hinder mammary development of gilts (Farmer et al., 2004). Recent findings indicate that the composition of the diet fed to prepubertal gilts also has an influence on their mammary development. Gilts fed 2.3 g/day of the phytoestrogen genistein from 3 months of age until puberty had an increased number of mammary cells at 183 days (Farmer et al., 2010). On the other hand, dietary supplementation with flax as seed, meal, or oil during prepuberty brought about the expected changes in circulating fatty acid profiles without any alteration in mammary development (Farmer et al., 2007b). Yet, when a 10% flaxseed supplementation was provided from day 63 of gestation until weaning, beneficial effects were noted in the mammary tissue of the female offspring of these sows at puberty (Farmer and Palin, 2008).

During gestation, feeding high energy may have detrimental effects on mammary development and subsequent milk production (Weldon et al. 1991) whereas the amount of dietary protein has limited effects on mammary development (Kusina et al., 1999a) but may increase subsequent milk production (Kusina et al., 1999b). On the other hand, Howard et al. (1994) found no effect of elevated energy intake in gestation on mammary development of pregnant gilts. Yet, when manipulating body composition of gilts by changing their protein and energy intakes during pregnancy, it was found that fat gilts on a high energy-low protein diet had reduced mammary development and produced less milk than lean gilts at the same body weight (Head and Williams, 1991 & 1995).

Mammary involution is an important process of the mammary gland and much remains to be learned about it in swine. Ford et al. (2003) reported that it is associated with dramatic changes occurring rapidly in the 7 to 10 days following weaning, and Farmer et al. (2007a) demonstrated that during a prolonged lactation (44 vs. 22 days) mammary epithelial tight junctions become leaky, which is indicative of the onset of the involution process. Mammary gland involution also takes place in early lactation due to glands not being suckled. It occurs rapidly during the first 7 to 10 days of lactation (Kim et al., 2001) and was shown to be an irreversible process after 3 days of non-suckling (Theil et al., 2005). This brings up the question of the importance of use of a teat in the first lactation on its productivity in the subsequent lactation. This is of great interest because producers try not to “over-use” first-parity sows to avoid the “thin-sow syndrome”. Fraser et al. (1992) suggested that non-use of a teat in the first lactation tends to reduce its productivity in the early part of the next lactation but this was never further investigated until recently. Results from a newly-terminated project (Farmer et al. unpublished data) show that piglets suckling in second parity a teat which was not used in first parity weigh 1.1 kg less on day 56. This is due to a lower weight gain during lactation. Interestingly, it appears that piglets can differentiate previously-suckled from previously-unsuckled teats as shown by differences in aggressive behaviour.

In conclusion, it is evident that a combination of factors are involved in predicting sow milk yield and with the current use of hyperprolific sow lines it has become imperative to provide the best-adapted management and feeding strategies to improve upon it. Special attention needs to be focussed on the nutrition of replacement gilts in order to ensure maximal mammary development and future milk yield potential. The use of bioactive feed ingredients, such as phytoestrogens, may prove to be useful tools in achieving this goal.

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NOTES

CHALLENGES OF SOW MILK PRODUCTION FROM THE CLINICAL POINT OF VIEW

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Introduction

Postpartum dysgalactia syndrome (PDS) in sows is characterized by inadequate and insufficient colostrum and milk production during the first days of lactation. Due to the multifactorial nature of the syndrome, the identification of the different risk factors and their relative impact is not straightforward (Martineau 2005). Logically, also the implementation of preventive and therapeutic measures is a challenge for pig veterinarians. The present paper discusses the importance of PDS and focuses on different factors that may affect milk production in sows. A sufficient number of healthy piglets are important for milk production, and consequently, a low litter size and/or weak born or diseased piglets may lead to a low milk production. A low milk production secondary to problems with the piglets will however not be discussed.

Prevalence and clinical symptoms

The prevalence of PDS either at animal or herd level depends upon the criteria used for assessing the occurrence and the severity of the syndrome. As these vary largely between studies, prevalence data of PDS from different studies are difficult to compare. Martineau et al. (1992) summarized a list of symptoms that may be present in the sow, the piglets and in herd productivity. For the sows: 1) Local symptoms: not present, mastitis with agalactia, vaginal discharge 2) General symptoms: not present, fever, prostration, anorexia (total or partial). For the piglets: 1) <1 week: increased mortality, diarrhea, increased heterogeneity among the litter 2) >1 week: increased heterogeneity among litter, low weaning weight. For the herd: decreased number of piglets/sow/year. In a given herd, not all sows exhibit the same range or intensity of symptoms, and also the number of affected sows may vary.

A recent study in 110 pig herds showed that 34% of the herds had experienced problems related to PDS during the last year before the study (Papadopoulos et al. 2010). This high percentage is explained by the fact that also herds with minor problems were considered as PDS herds.

Pathophysiology

Martineau et al. (1992) and Martineau (2005) suggested that interactions between endotoxin produced by Gram-negative bacteria in the gut and alterations in the immune and endocrine functions play a central role in the development of PDS. Nachreiner and Ginther (1974) challenged periparturient sows with lipopolysaccharide (LPS) endotoxin of E. coli and found that sows showed postpartum agalactia. de Rijter et al. (1988) proposed that the systemic disease in case of coliform mastitis in sows was a result of the formation of inflammatory

endogenous mediators in the mammary gland. Intramammary infusion of LPS in lactating sows was associated with an immune activation and lower serum concentrations of Ca and P (Wang et al. 2006). As many different hormones such as prolactine, relaxin and thyroid hormones are involved in mammary gland development, milk production and sow metabolism, alterations in these hormones may lead to decreased milk production (Farmer, 2011). Further research is necessary to elucidate the exact pathways involved in PDS.
Induction of parturition with F series prostaglandins was effective in reducing the incidence of MMA (Einarsson et al. 1975). The exact action mechanism of prostaglandins in relation to reducing the hypogalactia related symptoms is not clear. Farrowing induction potentially affects the kinetics of the periparturient cortisol surge in sows, which is essential for the maturation of fetal tissues. Foisnet et al. (2010) showed that sows injected with alfaprostol at day 113 of gestation had greater circulating concentrations of prolactin and cortisol compared to sows that were not induced to farrow. They also found a higher concentration of lactose in colostrum, and suggested that this might have been caused by the transient increase in prolactin and cortisol just after farrowing induction. In the same study, farrowing induction did not influence colostrum yield and IG concentrations. The effects of farrowing induction are however not that consistently positive in literature. Widowski et al. (1990) found that injection of a prostaglandin analogue in sows at day 112 of gestation led to a delayed increase in prolactin and delayed nest building behavior. Devillers et al. (2007) found a significantly lower colostrum yield (-15%) in sows when farrowing was induced. In the latter study, however, the effect of farrowing induction was confounded with a potential effect of gestation length (113 days for non-induced sows versus 114 days for sows with induced farrowing). Jackson et al. (1995) found a lower fat content level in colostrum in sows induced at day 112 of gestation, except if extra fat was supplemented to the diet.

Role of Nutrition and Feeding regime

During the peripartal period, the reduced feed intake and low fiber content frequently lead to dryer and harder feces, indicating an impaired passage of chyme and subsequent constipation (Kamphues et al. 2003; Oliviero et al. 2009). Constipation frequently occurs in periparturient sows, not only because of feed or feeding techniques but also parturition itself influences the dry matter content of feces. Hermansson et al. (1978) reported constipation to occur in approximately 25% cases of agalactia post partum in sows. By increasing the dietary fiber content at the end of gestation, there is a decrease in the incidence of constipation (Oliviero et al. 2009). This may lead to lower intestinal microbial growth and less release and absorption of endotoxins from the digesta (Martineau et al, 1992). Göransson (1989) reported that sows that are too fat at parturition were at higher risk for PDS. Neil et al. (1996) showed that only 16% of the sows that were allowed feed ad libitum before or on the day of farrowing became agalactic, whereas 31% became agalactic when the sows were allowed feed ad libitum after the day of farrowing. Papadopoulos et al. (2010) found that feeding sows

ad libitum shortly after farrowing increased the risk for PDS (OR=3.1) compared to feeding sows restrictedly.
Papadopoulos et al. (2009) also showed that a lactation diet low in n-6:n-3 ratio administered to sows from 8 days before farrowing improved feed intake during the first days postpartum and was associated with a better metabolic change and inflammatory profile, when compared to a lactation diet high in n-6:n-3 ratio and/or administered from 3 days before farrowing. This means that also the feed composition and more specifically the type of fat is important.
Mahan (1991) showed that agalactia was a problem in sows fed the basal vit E level (16 or 33 IU/kg) and to a lesser extent, in those fed the 66 IU/kg dietary level. Low-grade incidences of MMA occurred in all sow treatment groups, but milk letdown and subsequent milk production was more problematic in sows receiving the diets with lower vit E levels.
Grains contaminated with ergot derivatives of Claviceps Purpurea may disturb milk production in sows (Kopinski et al., 2007). The effects are likely due to suppressed prolactin secretion by ergot toxins.
Diets containing probiotics given at the end of gestation and around parturition may lead to a reduction in the incidence of MMA (6 vs. 13%) and higher feed intake during lactation (Böhmer et al. 2006). Addition of formic acid to the diet (10 g/kg) of pregnant and lactating sows showed beneficial effects on performance and agalactia.

Housing and management practices
The incidence of PDS was higher in sows housed in crates with a width of 60 cm compared to sows in crates of 67 cm width (Cariolet, 1991). The incidence was also higher in sows subjected to an abrupt change of environment from pasture gestation to restraint in crates a few days before farrowing (Backstrom et al. 1984). Papadopoulos et al. (2010) found that moving pregnant sows to the farrowing unit 4 days before expected farrowing compared to moving the sows 7 days or earlier before farrowing increased the risk for PDS (OR=6.2). A period of acclimatization of the sow to the new farrowing-lactation environment appears to be necessary.
The use of slatted floors in the farrowing pens was associated with a decreased risk of chronic mastitis in sows (Hultén et al. 2004). Oliviero et al. (2008) showed that duration of parturition was significantly longer for sows housed in crates with no bedding material (311 min) compared to sows in farrowing pens enriched with straw bedding (218 min). Overheating of the mammary glands by inappropriate placement of heating lamps decreases milk production (Muirhead and Alexander, 1997). The effects of heat stress in lactating sows include lower feed intake and milk production (Quiniou and Noblet 1999). Other studies have suggested that high ambient temperatures have a direct effect on sow milk production, independent of the reduction in feed intake (Messias de Braganca et al. 1998).
Appropriate hygiene measurements like washing the sows and the use of disinfectants in the farrowing rooms were reported to lower preweaning mortality and the incidence of chronic mastitis in sows (Hultén et al. 2004), respectively.
Farrowing induction has been identified as a risk factor for PDS (OR=4.8) (Papa-

dopoulos et al. 2010) as well as for a lower colostrum yield (Devillers et al. 2007). However, earlier studies reported that induction of parturition with F series prostaglandins was effective in reducing the incidence of MMA (Einarsson et al. 1975; Holtz et al. 1983). The results of the different studies cannot be compared as such because of major differences in study design (timing of injection, dosage, type of prostaglandin, parameters of comparison and timing of measurements, experimental vs. observational study) and study population (primiparous sows vs. sows of all parities).

No frequent farrowing supervision compared to frequent supervision increased the risk for PDS. Supervision and assisting sows exhibiting dystocia may help reducing the occurrence of PDS (Bäckström et al. 1984).

Conclusions

A considerable number of modern pig herds suffer from problems with PDS, a syndrome with a complex pathophysiology and with several and different risk factors involved. Control measures should focus primarily on the specific risk factors in affected pig herds. Efficient control measures mostly imply optimization of feeding, housing and management practices.

References

Table: Risk factors related to nutrition, housing and management for porcine dysgalactia syndrome

Potential risk factor	Reference
Nutrition	
Constipation	Hermansson et al. (1978); Martineau et al. (1992)
Feeding sows ad libitum shortly after farrowing compared to feeding sows restrictedly	Papadopoulos et al. (2010)
Feeding sows ad libitum one day before parturition compared to one day after parturition	Neil et al. (1996)
Sows too fat at parturition	Göransson (1989)
Low vit E level (16 or 33 IU/kg vs. 66 IU/kg dietary level)	Mahan (1991)
Ergot intoxication	Kopinski et al. (2007)
Housing	
Crates with a width of 60 cm compared to crates of 67 cm width	Cariolet (1991)
No slatted floor in farrowing pens	Hultén et al. (2004)
Overheating of mammary glands	Muirhead and Alexander (1997)
High ambient temperatures and heat stress	Quiniou and Noblet (1999), Messias de Braganca et al. (1998)
Management	
Farrowing induction	Papadopoulos et al. (2010)
No supervision of farrowing compared to frequent supervision (>50% of farrowings)	Papadopoulos et al. (2010)
No washing of sows and no use of disinfectants in the farrowing rooms	Hultén et al. (2004)
Abrupt change from pasture gestation to restraint in crates a few days before farrowing	Backstrom et al. (1984)
Moving pregnant sows to the farrowing unit 4 days before expected farrowing (OR=6.2) compared to moving the sows 7 days or earlier before farrowing	Papadopoulos et al. (2010)

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NOTES

AN UPDATE ON PATHOGENESIS AND CONTROL OF SALMONELLA INFECTIONS IN PIGS

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PATHOGENESIS OF SALMONELLA INFECTIONS IN PIGS

In order to be able to come up with efficient control measures to combat Salmonella infections in pigs, for example by means of vaccination, detailed knowledge of the pathogenesis should be the starting point.

Transmission of Salmonella between pigs is thought to occur mainly via the faecal–oral route. Depending on the inoculation dose and the used strain, experimental oral infection of pigs with Salmonella Typhimurium may result in clinical signs and faecal excretion of high numbers of bacteria. During ingestion, Salmonella enters the tonsils in the soft palate and persists in the tonsillar crypts. The palatine tonsils are often heavily infected in pigs and should, therefore, not be underestimated as a source of Salmonella contamination during slaughter. Surprisingly little information has been gathered on how Salmonella interacts with and persists in the porcine tonsillar tissue. Persistence of Salmonella on the superficial epithelium of the tonsillar crypts has been reported (Van Parys et al., 2010). The mode of colonization of the tonsils is probably very different from the mechanism of colonization of the intestines (Boyen et al., 2006). Very recently, various genes that are expressed in the porcine tonsils during persistent infection have been identified using the in vivo expression technology (Van Parys et al., submitted). Bacteria that are swallowed and survive passage through the stomach, reach the gut. In the distal parts of the intestine, adherence to the intestinal mucosa is generally accepted to be the first step in the pathogenesis of Salmonella infections in pigs. It has recently been shown that in epithelial cells, reversible adhesion of Salmonella Typhimurium is mediated by type 1 fimbriae and irreversible adhesion (docking) is Salmonella Pathogenicity Island 1 (SPI-1) mediated (Misselwitz et al., 2011). Both type 1 fimbriae and SPI-1 have been shown to contribute to the colonization of the porcine intestinal tract. Following adhesion, Salmonella invades the intestinal epithelium. Salmonella Typhimurium can be found within the porcine enterocytes and mesenteric lymph nodes at 2 h after oral inoculation. Recently, it has been shown that the virulence genes encoded in the SPI-1 mediate this invasion step and that these genes are crucial for the colonization of the porcine gut and GALT. The rapid growth of Salmonella Typhimurium in the porcine gut and subsequent induction of pro-inflammatory responses may explain why pigs in most cases confine Salmonella Typhimurium infection to the intestines, whereas slow replication of Salmonella Choleraesuis may enable it to evade host immunity and subsequently spread beyond the intestinal boundaries.

The systemic part of a Salmonella Typhimurium infection in pigs is not well-documented. It is generally accepted that Salmonella can spread throughout an organism using the blood stream or the lymphatic fluids and infect internal organs, although this has not yet been studied in detail in swine. The colonization of the gut associated lymphoid tissue (GALT), spleen and liver can result in prominent systemic and local immune responses. Macrophages are the cells of interest for Salmonella to disseminate to internal organs of different host species. The bacteria replicate rapidly intracellularly and cause the systemic phase of the infection, while interfering with the antibacterial mechanisms of the macrophages and inducing cell death. In pigs, non-typhoidal serotypes such as Salmonella Typhimurium, can reach liver and spleen shortly after experimental inoculation, but are cleared from these organs a few days after inoculation. At this time, the bacteria are still found in the gut, gut-associated lymph nodes and tonsils. These infections may result in long-term asymptomatic carriage of the bacterium. Since this carrier state in pigs is difficult to detect in live animals, either by bacteriological or serological methods, these pigs can bias monitoring programmes. Very few researchers have made an attempt to unravel the mechanism of the concealed, but prolonged infection in carrier pigs. Recent evidence suggests that Salmonella Typhimurium interferes with seroconversion in pigs, and that this phenomenon might be related to strain-dependent persistency capacities (Van Parys et al., 2011).

Stress-induced excretion of Salmonella Typhimurium by carrier pigs transported to the slaughterhouse may cause contamination of shipping equipment and holding areas, resulting in preslaughter transmission of Salmonella to non-infected pigs. Although the mechanism of this stress-induced excretion is not known, there are some indications that catecholamines and/or cortisol may play a role. It has been shown that Salmonella Typhimurium can “sense” catecholamines and as a result increase its growth rate. It has very recently been shown that the presence of cortisol has marked effects on the intracellular fate of Salmonella Typhimurium in porcine macrophages (Verbrugghe et al., 2011). The mechanism and the bacterial factors playing a role in this phenomenon are currently under investigation.

DESIGNING CONTROL MEASURES BASED ON INSIGHTS IN THE PATHOGENESIS

Organic acids

The last few years, there is a widespread interest in “natural methods” to inhibit the spread of pathogenic bacteria in farm animals. Commercial preparations consisting of different kinds of organic acids not only appear to improve feed conversion and growth of animals, but also pathogen control has been reported, especially in poultry. The antibacterial effect of these products depends on the type of organic acid, the bacterial species, the used concentration and the physical form through which it is administered to the animals. The composition of the currently used products is mostly empirically determined. Recent research suggests that Salmonella Typhimurium mainly uses two distinct sites and mechanisms for colonization of pigs, namely the tonsils on the one hand and the intestine and associated lymph nodes on the other hand. In order to combat Salmonella infections in pigs, measures that interfere with both tonsillar and intestinal colonization will probably yield the best results. Since the mechanisms of colonization of these sites seem to be different, the control measures should be designed accordingly.

Upper gastrointestinal tract
Contaminated feed is a well-known source for Salmonella introduction to the farm. The original concept of incorporating acids into the feed of poultry was based on the notion that the acids would decontaminate the feed itself and prevent Salmonella uptake. Even though no thorough research has been conducted concerning the control of a Salmonella infection at the tonsillar level, it seems likely that a similar effect could be achieved in the oral cavity. The type of acid and the concentration used would very important. The administration of acidified drinking water in pig farms has been reported to lower the prevalence of serologically positive pigs, even though this could not be confirmed in a recent controlled study (De Ridder et al., 2011). On the other hand, acid adaptation and acid tolerance genes have been described in Salmonella Typhimurium. Therefore, acidification of drinking water might even pre-condition Salmonella to survival in acid conditions, possibly reducing the effectiveness of the antibacterial barrier of the stomach.

Lower gastrointestinal tract
Orally administered organic acids are rapidly taken up by epithelial cells along the alimentary tract, thereby disappearing from the highly relevant lower parts of the gastrointestinal tract (ileum, caecum, colon). Therefore, researchers have attempted to transport the organic acids further down in the gastrointestinal tract by micro-encapsulation, which should prevent absorption of the acids in the upper tract. Certain short- and medium-chain fatty acids have been shown to decrease Salmonella invasion in enterocytes through the downregulation of SPI-1 encoded genes (Boyen et al., 2008). The concentrations of the acids necessary for this effect are below those necessary to exert a direct antimicrobial effect. Considering the importance of invasion in the colonization of the porcine gut, one could expect that any measure that interferes with this invasion step will decrease the bacterial load in the gut. Indeed, using coated butyric acid, we were able to lower intestinal colonization, spread between pigs and bacterial shedding in the faeces in independent and controlled studies (Boyen et al., 2008; De Ridder et al., 2011).

Vaccinating against Salmonella in pigs
Considering the positive effects of vaccination of laying hens on prevalence of Salmonella Enteritidis in eggs and Salmonella Enteritidis infections in humans, vaccination could also be a major tool to control Salmonella in pigs. The evidence available in scientific literature suggests that Salmonella vaccination is in fact associated with reduced Salmonella prevalence in swine at or near harvest.

In addition, there are indications that even subclinical Salmonella infections can lead to weight gain losses in pigs indicating that vaccination to control salmonellosis in pigs may have an economic incentive for pig producers as well (Boyen et al., 2009; Farzan and Friendship, 2010).

Activating innate, mucosal, humoral and/or cellular immune response?
Vaccination might be able to reduce porcine carcass contamination and subsequently infections in humans in different ways, by interfering at different stages of the pathogenesis: inhibit early colonization, reduce excretion thereby lowering infection pressure at farm level, decrease spread between pigs by increasing the infective dose threshold, interfere with the development of the carrier state in the various target organs (gut, GALT and tonsils) and prevent the stress-related re-excretion at slaughter. To inhibit early colonization, adhesion to and/or invasion in epithelial intestinal cells should be blocked. This could probably be best achieved by attaining high levels of mucosal IgA. There are no indications which porcine immune response(s) are most important for reducing excretion shortly after infection, during the carrier state or in stress-related re-excretion periods. To interfere with the development of the carrier state, it can be expected that both the humoral and cellular immune response will be important. Probably innate, mucosal, humoral and cellular immunity all play a role in increasing the infective dose threshold.

Using live attenuated or inactivated vaccines for optimal effects?
At present, live vaccine strains are considered to offer a better protection against Salmonella infections compared to inactivated vaccines, probably due to the more pronounced cellular immune response and the induction of mucosal IgA production. Additional advantages of live vaccine strains are the possibility to administer these vaccines at a very young age, despite the presence of maternal antibodies, the flexibility of a live vaccine strain to switch to different colonization strategies at different target organs (gut-tonsils) and the possibility to administer it by mixing it in feed and/or water supply. The most difficult aspect of creating a good live attenuated vaccine is finding the perfect balance between attenuation to assure safety on the one hand and residual potency to assure the induction of a protective immune response on the other hand.
Bacterial attenuated vaccine strains can be divided in three types: (1) strains, which are attenuated without the attenuation being localised or characterised, (2) strains with mutations in genes that are important for the bacterial metabolism, for example auxotrophic mutant strains, (3) strains in which specific (virulence) genes were removed. The advantage of the latter group is that the vaccine strains are very well characterised and that reversion to the wild-type phenotype is extremely unlikely. Strains that lack one or more virulence genes important for clinical salmonellosis or for the induction of persistent infections in pigs might represent promising candidates for future vaccine development. Recent research has identified various virulence genes, playing a role in different stages of the pathogenesis of Salmonella Typhimurium infections in pigs. These findings may contribute to the development of more efficient and safer live attenuated vaccines.

Vaccinating sows or piglets?

Various researchers have reported that Salmonella prevalence at slaughter age is predominantly a result of infection during the finishing period, especially in multi-site herds. Therefore, currently, most control measures, including vaccination, are mainly focussed on older piglets and slaughter pigs. These strategies may indeed influence Salmonella prevalence and shedding at the end of the production cycle, but are not able to interfere with infection pressure and spread of the bacterium at younger stages of life. These early stages of the production cycle, can nevertheless be a crucial factor for the initial contamination of pig batches, especially in pig farms where biosecurity and cleaning-disinfection protocols are good to excellent. It has been shown that early infection, occurring between birth and weaning, seemed to be a critical point for the Salmonella spread within a pig batch, and possibly within a herd and that sows may play an important role in the maintenance of Salmonella infections in farrow-to-finish herds (Nollet et al., 2005).

Interference of vaccination with Salmonella monitoring programmes

The purpose of monitoring and control programs is to reduce the risk of public health problems arising from the consumption of contaminated pork, reducing human disease and maintaining consumer confidence. Implementation of monitoring programs and coordination of control measures at harvest and post-harvest, are being used worldwide to prevent non-typhoidal Salmonella infections in humans from contaminated pork. Extensive national monitoring and control programs at the farm level (preharvest) are mostly conducted in the European countries. Most European monitoring programmes are based on serological screening, thus categorising the pig herds according to their assessed risk of carrying Salmonella into the slaughter plant Farmers with herds belonging to the category with the highest risk of introducing Salmonella into the slaughterhouse are assisted by the national governments to reduce the Salmonella load of their herd. There is currently one Salmonella vaccine registered for use in pigs in Europe which is a live attenuated vaccine. Even though this vaccine has promising features to decrease the Salmonella load on farm, the induced immune response interferes with the national control programmes of most of the European member states. A variant of this vaccine that enables differentiation of infected from vaccinated animals (DIVA) has been described (Selke et al., 2007). However, to differentiate vaccination with this DIVA strain from infection in the European monitoring systems, a new ELISA detection system should be implemented and validated in all European member states, which is very time consuming and expensive. A marker vaccine that would not interfere with the European (and/or other) control programmes would mean a huge step forward. Recent research by Leyman et al. (2011) has shown that the deletion of an LPS encoding gene might create a DIVA marker strain that would not interfere with the current European control programmes.

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NOTES

ROLE OF NUTRITION (DIETARY STRATEGIES) ON SALMONELLA PREVENTION

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Zoonotic microorganisms are a challenge at all levels of the food production chain, including pork production. With regard to the highest reachable safety standards for all kinds of food not only the consumer will make demands on special standards in the food production but the market partners as well. Against this background the appearance of Salmonella in pig stocks deserves special attention.

With the new Pig-Salmonella-Regulation (17.03.2007) in Germany adequate controls and measures will be obligatory to reduce the prevalence of Salmonella in pigs. Among all others the livestock owners are especially charged. Apart from general hygiene measures (stock shielding, rodent control, etc.) feeds and feeding should also be included within those efforts. In the past especially feeds were seen as a possible way of entry for Salmonella, whereas today feeds and feeding are considered as measures to reduce the Salmonella–prevalence. From different epidemiological and experimental studies it is known that there are advantages (which means minimizing the Salmonella-prevalence) by using less intensively ground ingredients (with larger particle size) in the feed and coarse meal, respectively, compared to pelleted diets. Regarding a “coarser structure” the type of ingredients is of importance as well. In Denmark the advice has been given for many years to use higher proportions of barley, whereby (even though it is ground like wheat) a “coarser structure” will be obtained.

In addition to that, positive effects regarding Salmonella-prevalence have been observed by using special feed additives (organic acids and their salts).
The effect of these additives is explained by reducing counts of bacteria in the cranial digestive tract, while the coarser particles of the meal act in the stomach (supporting acidification of the stomach content; very finely ground feed sticks together, inhibiting acidification), but even to a higher extent in the hindgut: increased amounts of starch entering the caecum and colon followed by a higher production rate and concentration of propionic and butyric acid in the chyme. The efficiency of the coarse diets, considering the Salmonella-prevalence, can be explained by recent investigations and results from constitutive microbiological groups which deal with the matter of certain organic acids for gene expression (invasion genes) in Salmonella.

Because of the lower grinding intensity adverse effects on the energetic value for the pig is certainly involved and higher values for the feed conversion ratio are therefore expected. It should also be emphasised that these dietetic concepts are only applied in cases of special need, meaning individual farms with relevant problems.

Finally grinding more coarsely has additional favourable effects regarding the occurrence of gastric ulcers which are not seldom seen in sows and fattening pigs fed pellets with higher proportions of fine particles.

Keywords: pigs, feeds, feeding, grinding, diets' physical form, Salmonella-prevalence, experiments, field studies

Table 1: Prevalence of Salmonella spp. in samples of feed and drinking water on farms producing porc in Germany

farms for	diets/feeds tested samples		drinking water tested samples		authors
	in total (n)	positively (n)	in total (n)	positively (n)	
- reared piglets	100[1)2)]	0	46	0	Offenberg (2007)
- fattening pigs	107[2)3)]	0	97	0	Visscher (2006)
	136	1	95	1	Meyer (2004)
	226	1	59	0	Battenberg (2003)

1) 72 samples of diets taken at the farm, further 28 samples taken at producing industry
2) testing by cultural technique
3) testing additionally by PCR technique

Table 2: Results on Salmonella detection in rectal swaps (individual testing) and feces (pooled samples within one group) of piglets during rearing period on flat deck under the influence of two dietary strategies tested parallelously (control: diets ground finely and pelleted; experimental group: diets ground coarsely, non pelleted diet) on two farms affected by a higher Salmonella prevalence (OFFENBERG 2007)

flat deck phase		start bw: ~ 8 kg		middle bw: ~ 15 kg		end bw: ~ 27 kg	
farm I		control	exper.	control	exper.	control	exper.
individual samples (rectal swaps)							
- testet positively	- absolute (n / n)	20 / 307	2 / 289	15 / 288	9 / 282	8 / 282	2 / 288
	- relatively (%)	6.51	0.69	5.21	3.19	2.83	0.69
pooled samples of feces (from groups of piglets)							
- tested positively	- absolute (n / n)	7 / 48	0 / 36	11 / 48	5 / 36	8 / 48	3 / 36
	- relatively (%)	14.6	0	22.9	13.9	16.7	8.33
farm III		control	exper.	control	exper.	control	exper.
individual samples (rectal swaps)							
- tested positively	- absolute (n / n)	0 / 128	0 / 128	8 / 128	2 / 128	16 / 128	1 / 128
	- relatively (%)	0	0	6.25	1.56	12.5	0.58
pooled samples of feces (from groups of piglets)							
- tested positively	- absolute (n / n)	0 / 16	0 / 16	1 / 16	1 / 16	3 / 16	0 / 16
	- relatively (%)	0	0	6.25	6.25	18.8	0

control = control group, (diets ground finely) exper. = experimental group (diets ground coarsely) bw = body weight

Table 3: Characterization of diets/dietary treatments used in two consecutive fattening trials on three farms in the field studies of VISSCHER (2006)

farm	group	additives		proportions (%) of particles' size 3)		diets offered as
		trial 1	trial 2	> 1.4 mm	< 0.4 mm	
farm I	control	F / P	F / P	12.4	35.9	crumbles
	experim.	F / P	F / P	36.1	26.7	
farm II	control	-	-	15.8	27.2	crumbles
	experim.	KDF 1)	KDF 1)	58.8	13.1	
farm III	control	F / P	F / P	14.8	31.6	pellets
	experim.	F / P	KDF 2)	38.5	27.9	

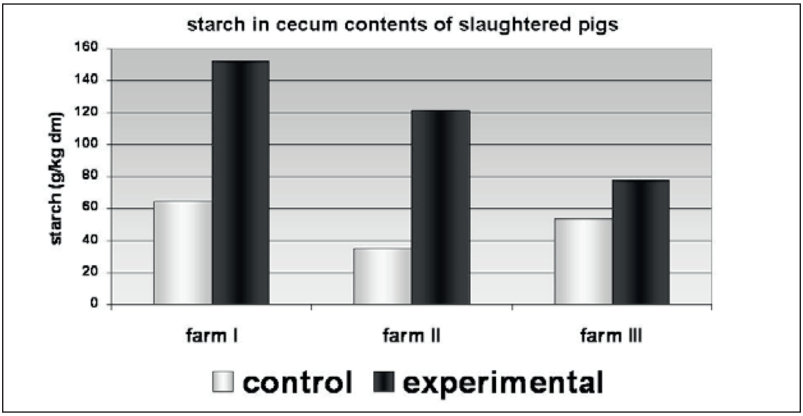
F = formic acid P = propionic acid KDF = potassium diformate
1) in the finisher diets only
2) continously in all fattening diets
3) estimation of particles' size in the ground mixed diet before pelleting/crumbling by dry sieve analysis

Table 4a: Prevalence of Salmonella in meat juice (positively tested = optical density (%) ≥ 40; n/n = positive samples / tested in total) as well as in organs/tissues/samples of pigs at slaughter; pigs of three farms with different two feeding strategies during the whole fattening period (finely/coarsely ground diets; different feed additives in use)

		farm I – III		farm I – III	
group		control	experimental	control	experimental
diets ground		finely	coarsely	finely	coarsely
samples	trial	n / n	n / n	pos. (%)	pos. (%)
- meat juice	1	16 / 110	1 / 92	24.4	5.95
	2	35 / 99	10 / 93		
- tonsils	1	22 / 87	12 / 90	38.8	13.2
	2	49 / 96	12 / 92		
- bile	1	0 / 88	3 / 90	4.30	1.66
	2	8 / 96	0 / 91		
- Lnn. ileocaecales	1	11 / 89	18 / 91	19.5	13.7
	2	25 / 96	7 / 92		
- cecum content	1	31 / 99	6 / 91	45.1	15.3
	2	57 / 96	22 / 92		
- samples of surfaces 1)	1	0 / 91	3 / 90	8.15	3.85
	2	15 / 96	4 / 92		

1) taken from the inner but also the outer surface of the carcass at the slaughterhouse

Figure 1: Starch concentrations in cecum contents of pigs (at slaughterhouse) fed diets differing in their physical form (control pigs: finely ground diets; experimental pigs: coarsely ground diets) based on VISSCHER et al. (2009)

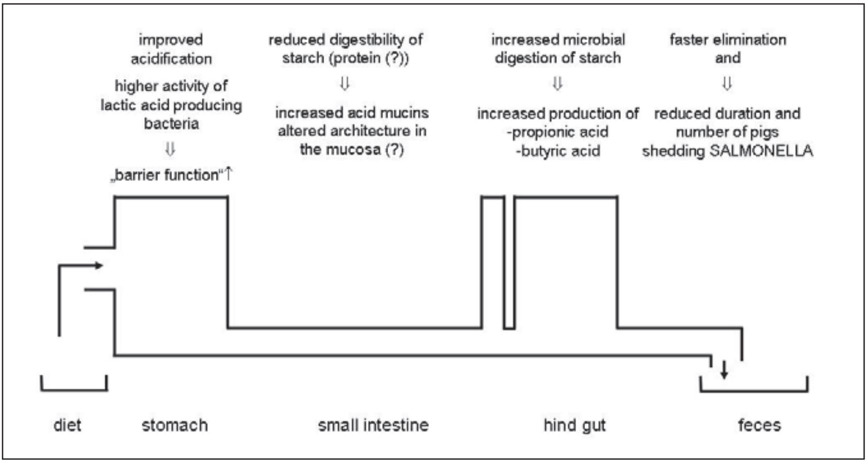


Lawhon et al. 2002:
(Molecular Microbiology 46, 1451 - 1464)

"It is likely then that Salmonella can use the SCFA conditions of the mammalian intestinal tract as a signal for invasion. Low total SCFAs (– 30 mmol) with a predominance

– of acetate induce invasion
  whereas
– high toal SCFAs (– 200 mmol) with greater concentrations of propionate and butyrate suppress it."

Figure 2: Ideas behind the concept „coarse diets against Salmonella" in pork production (based on different published studies including own experimental work and field surveys)



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NOTES

IMMUNIZATION BY VACCINATION OF PIGS

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Nowadays, the maintenance of a high health status in pig farms of Europe has become a key element for the swine industry. Firstly because of the need and obligation to produce healthy foods; secondly because disease costs money as a consequence of direct losses, because of complicating conditions and because the need to administer treatments to diseased animals. Also, there is an increasing pressure coming from the public opinion –and from regulatory agencies as well- for decreasing the use of antimicrobial agents. In this context, the affirmation that "better to prevent than to treat" has become now, more than ever, an axiom. When dealing with infectious diseases, hygiene and vaccines are the kernel of prevention.

In pigs, as in other livestock production, immunization through vaccination must be understood as a herd intervention which general objectives can range from just controlling the appearance of clinical outbreaks or minimizing the incidence of cases of a given disease – without elimination of the pathogen- to eradication. Moreover, the particular objectives of vaccination in pigs will differ depending on what group of animals is to be vaccinated, namely, gilts, sows or piglets. The aim of vaccination in gilts is primarily to induce for the first time immunity against those pathogens actually present –or potentially present- in the farm as a part of what is usually denominated the acclimatization period. A typical example of this is could be vaccination against porcine parvovirus. Usually, the goal of vaccination in sows is to produce memory/boost responses against pathogens for which previous vaccination has been performed either as a mean to protect the sow or as a mean to transfer immunity to piglets (see later). In this instance, vaccination is usually focused, but not always, in late pregnancy and aims to produce high levels of antibodies in colostrum or milk. With regards to this, it is worth to remember here that while immunoglobulins in colostrum will be absorbed through the gut (only for 24-36 h of birth) producing thus systemic immunity, inmunoglobulins in milk will not be absorbed and will have a local, but extremely important effect in intestines, mainly through IgA.

Both in gilts and sows, use of vaccines can be determined by the physiological status of the females, particularly regarding the use of attenuated (replicative) vaccines or strong adjuvants in pregnant sows.

Vaccination in piglets is mainly aimed to the prevention of systemic or respiratory diseases and often confronts the problem of interference with maternal-derived antibodies. The sooner piglets are vaccinated, the sooner will be protected but the stronger the interference with maternal antibodies. The practical significance of this blocking by maternal antibodies can range from nil to extremely important.

In some instances, commercial vaccines are not available or are available only against a few subtypes of a given pathogen. In those cases, auto-vaccines are an alternative. Generically, auto-vaccines can be defined as vaccines produced "on demand" made from the specific strain or isolate causing a problem in a given farm. These types of vaccines are most often directed to bacterial pathogens such as streptococci, haemophili, etc. Although these vaccines can be very useful in particular situations, extremely care has to be applied in all the process, including a very accurate diagnosis of the cases and to the correspondence of isolates of the bacterial agent with the pathogenic strain when virulent and avirulent variants can be found in a farm. Also, the inactivation of the product, the follow-up of potential adverse reactions and the monitoring of the efficacy are important elements to be taken into account.

From a practical point of view, the main causes for "vaccine failures" (in a very broad sense) can be classified in three categories: a) inadequate vaccination procedures; for example, injection of the vaccine in the fat of the neck area or incomplete delivery of the vaccine doses; b) inadequate vaccination schedules; for example, giving just one dose in a two-doses vaccine schedule and, c) interference with maternal antibodies. Besides this, in other cases protection afforded by a given vaccine can be limited to a number of strains or serotypes of a given pathogen. For example, protection in influenza is highly dependent of the subtype and even within a subtype (i.e. H1N1 or H3N2), different variants can have more or less cross-reactivity or, when colostral protection against enterotoxigenic E. coli is sought, correspondence of the antigens included in the sow's vaccine with the virulence factors of E. coli circulating in piglets is crucial. In these cases, accurate pre-vaccination diagnoses are strongly needed.

Another important issue is how to verify the efficacy of the vaccination program. At a basic level, the clinico-pathological monitoring of the farm and keeping good records of productive/reproductive parameters is an important element. Secondly, serological monitoring can be used in different ways. In some instances, for example in countries where Aujeszky's disease virus (ADV) vaccination is performed, serology may be useful to assess infection/immunization status because of the differential nature of ADV vaccines. In other instances, for example porcine parvovirus, serology may be used in a reverse way, that is, to assess if gilts are adequately immunized and to detect inadequate vaccination procedures or schedules (i.e. seronegative animals entering the sow's stock). In other instances, monitoring of vaccine efficacy would be only limited to a more or less thoroughly search (virological, bacteriological, etc.) of the pathogen against which vaccination is performed.
In summary, vaccination is one of the more valuable tools for preventing infectious diseases in pigs. The efficacy of the vaccination programs will depend on the definition of clear objectives, well-defined schedules and planned monitoring programs. In the near future, more and newer vaccines will help to increase the health of pig herds.

NOTES

HOW TO DESIGN VACCINATION PROGRAMMES FOR PIG HERDS

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Introduction

Vaccines have been applied in pig herds for many years with great success. Vaccination was originally designed to control clinical signs of disease. However the evolution in vaccine production has brought about the possibility of using marked vaccines for the eradication of diseases, as is the case with Aujeszky's Disease or Classical Swine Fever. Vaccination programmes are more important today than they were some years ago. The change in the perception of pig production: "Twenty years ago we produced pigs, but today we produce food" has had a big influence. The pressure to reduce antibiotic usage to avoid resistance problems in humans has made vaccines indispensable in the control of diseases in pig farms.

A series of decisions has to be taken when designing a vaccination programme: which diseases have to be covered by vaccines, which type of vaccine has to be used, when the vaccines will be applied, how many revaccinations are needed, etc. These decisions will differ from farm to farm as they will depend on a number of factors: the official requirements in each particular country, the most risky diseases for the farm based on their bisosecurity, the enzootic problems present on the farm to be covered, type of herd, the efficiency of a specific vaccine, the safety of the vaccine, the return over investment ratio, etc… This paper will try to review this decision process.

Which diseases have to be included in a particular vaccination programme?

Vaccination programmes vary from country to country. Availability of vaccine products is different as registration processes are not the same. National authorities will decide which vaccines are compulsory and how they have to be applied in practice, and also which vaccines are forbidden and consequently cannot be included in the programme. In those cases in which the country is considered officially free from a particular disease, any measures which could represent a risk for the detection of the presence of such disease has to be forbidden. This is the case with vaccination against Foot and Mouth Disease or Classical Swine Fever in most EU countries, or vaccination against Aujeszky's Disease in Denmark or the United Kingdom, which are considered free of such diseases. However, when a country is still suffering from the presence of a particular disease which affects the normal trading of animals, a national eradication programme for it will frequently be in place (Katharina DC, 2006). The first aim of any eradication plan would be to control the disease. Vaccines are commonly included as one of the key tools during the control phase. Aujeszky's Disease eradication programmes would be a good example of this (Bätza H.J. 2000). During the control phase, vaccination with marked vaccines would be compulsory. Where Classical Swine

Fever or Foot and Mouth Disease are still endemic, the OIE will recommend vaccination and most of the affected countries will follow this recommendation. Marked vaccines for Classical Swine Fever will be the preferred ones during the control phase if the final aim is eradication (Martens, 2003).

In order to proceed with the designing of the programme it is necessary to know what infectious diseases the herd is free from. The most common use for a vaccine is to prevent the clinical signs of the disease and therefore reduce financial losses. However disease prevention will depend also on farm location, replacement source (sows and boars) and biosecurity measures:

• Good location can avoid vaccinating against airborne diseases which are not present in the herd. This will be the case with *Mycoplasma hyopneumoniae* or *Aujeszky's* Disease (when it is not compulsory). Of course location has to be combined with a clean and safe replacement source and good biosecurity.
• Good health control of the replacement source will be critical to skip vaccination against diseases which need direct or close contact to be transmitted; such is the case with Atrophic Rhinitis or *Actinobacillus pleuropneumonae*.
• Assuming the herd has a safe replacement source, biosecurity will become critical to prevent diseases transmitted by faeces, such as Swine Dysentery or by vectors such as PRRS.

But in those particular situations where there is a known risk of disease introduction, before including a vaccine in the farm vaccination programme, a financial analysis should be carried out. Vaccines have to be considered as an investment and not just as a cost. As in any business where money is invested, a return over this investment is expected. The aim would always be the same: to invest the least amount of money possible to get the maximum benefits (Morrison, 2010). Sometimes, especially for those diseases which can be treated with antibiotics, perhaps a more economical option would be to substitute the vaccination by a fast treatment when the first signs of the disease appear. This would be the case with *Mycoplasma hyopneumoniae, Brachyspira hyodysenteriae or Actinobacillus pleuropneumoniae*.

Most infectious pig diseases will become enzootic once they have been introduced into a herd. Vaccines will be very useful in these cases to avoid clinical signs and to reduce financial losses. For Aujeszky's Disease, Circovirosis, Atrophic Rhinitis, or *M. hyopneumoniae,* vaccination has become the best tool to control them. The production system will influence disease dynamics helping to control diseases, this is especially true in three site systems (Sibila M. 2004) where an all in - all out technology will be strictly applied, allowing in some situations vaccination to be avoided, as is the case with M. hyopneumoniae. However for an *A. pleuropneumoniae*, PRRS, or Swine Dysentery infection, the vaccines available are not so efficient and therefore variable results could be expected. For an *A. pleuropneumonae* or PRRS infection vaccine, efficiency will also depend on the particular strain present in the herd; therefore the decision to include the vaccine in the vaccination programme will vary from farm to farm.

There are some pathogens the introduction of which cannot be prevented by a good location, control over replacement source or biosecurity measures. *Clostridium perfringens, E. coli, Lawsonia intracellularis, Salmonella ssp., Haemophilus parasuis*, Parvovirus or *Erysipelothrix rhusiopathiae* would be good examples of this. We know that some of these pathogens can produce problems unless action is taken. Parvovirosis is a good example. Parvovirus will be present in faeces and will infect non-immune animals. Gilts can have maternal antibodies up to 180 days of age, losing their protection very close to the moment when they will be introduced into the reproductive herd. This circumstance will make them the most susceptible population to infection, putting their gestation at risk. Vaccination against Parvovirosis in this particular group will prevent the clinical signs of the disease, gilts will become infected but no detrimental effects will be derived from this. In most cases other pathogens can be controlled just by practicing good hygiene in the herd. This would be the case with *Clostridium perfringens, E. coli, Lawsonia intracellularis, Salmonella spp.* and *Erysipelothirx rhusiopathiae*. Vaccination against these pathogens cannot be approached as a general rule; each particular farm will need its own programme. However because the damage that some of them can produce could be very important, some veterinarians will prefer to vaccinate. For instance *E. coli*, as well as *Clostridium perfringens* infection could produce high mortality amongst non immune piglets if they are infected during the first days of life, the gilts' offspring being the most susceptible population and vaccination is a good way of reducing this particular risk. The same applies to Erysipelas. When the pathogen infects pregnant sows, abortion would be, in most cases, the first obvious sign and when it infects baby piglets, mortality losses can be very high. Erysipelas vaccines can prevent clinical signs very efficiently, avoiding their financial impact. When we consider *Lawsonia intracellularis* the situation is different, clinical signs are seen mainly during the growing or finishing phases, the clinical presentation being very variable: from acute to chronic. Vaccination has to be applied to piglets which means a higher vaccination cost, not only due to the number of doses needed but also to the labour required. When a vaccine is administered the return over investment is clear if clinical signs are present, but the possibility of using metaphylaxis to also control symptomatology makes the decision become a financial one, unless there are special restrictions on the use of medication in finishing, as is the case in some supermarket contracts. Because *Haemophilus parasuis* vaccines will not protect against all strains, the decision to vaccinate will depend amongst other reasons on the type of strain present in the farm. Salmonella infection in pig production is typically endemic and in most cases asymptomatic. It has become a substantial concern amongst food safety bodies, prompting voluntary and legislative responses aimed at monitoring and reducing the number of Salmonella-infected animals (Macewen, 2006). Vaccines have been seen as a possible tool to reduce the number of infected animals (A. D. Wales, 2011). In those countries where Salmonella control programmes are having an effect on the viability of positive pig farms, maybe vaccination has to be considered.

Which type of vaccine will be the best?
Basically three types of vaccines can be found on the market: modified live, inactivated and toxoid vaccines. The most common ones are modified live and inactivated vaccines. Both types have advantages and disadvantages:

TYPE	ADVANTAGES	DISADVANTAGES
Inactivated	No reversion to virulence Safe for pregnant animals Safe for immunocompromised animals No shedding of the virus	2 doses required in most cases
Modified live vaccine	Stronger and long lasting immune response Rapid immune response Parenteral or mucosal administration Less frequent adverse reactions	Higher potential for vaccine to induce disease Virus shedding Virus replication could be risky for pregnant or immunocompromised animals. Easily inactivated by mishandling

It is not always possible to choose the type of vaccine. For many processes there is just one type of product available on the market. But when the possibility of choosing does exist, making the right choice is very important. Where Aujeszky's Disease is still a problem it would be better to base the vaccination programme on marked modified live vaccines: a higher viral load is required to infect, less shedding of virus when animals become infected, minimal risk to induce disease (vaccines have been on the market for more than 20 years and to date there are no records of induced disease because of the vaccine) (Vannier, 1991). Vaccination against PRRS with either modified live or inactivated vaccines alone has not produced good results in practice. Recently it has been shown under experimental conditions that the combination of both vaccines (modified live vaccination followed by inactivated vaccination) resulted in a rapid increase in seroneutralizing antibodies and immunized pigs had reduced viremia and lung lesions associated with PRRS following the challenge (Nulibol, D. 2007). Live vaccines could also be used on mucosa to develop a stronger local immunity and also to allow overtaking maternal immunity. Aujeszky's modified live vaccine could be used intranasally in very young animals independently of their maternal antibody titters, producing a good protection (Van Oirschot JT, 1987). Vaccines against mucosal agents will give better results when the vaccine used is a modified live one, this is for example the case with vaccination against Ileitis (Messier, 2008) or E.coli enterotoxigenic which will need the development of mucosal immunity in order to protect the animals (Haesebrouck, F. 2004).

Toxoid vaccines include inactivated toxins that will develop immunity against toxins of different pathogens responsible for clinical signs. These types of vaccine are employed to control diseases produced by bacteria producing exotoxins, such as *E.coli, Clostridium*, Atrophic Rhinitis and *Actinobacillus pleuropneumoniae.* The degree of protection induced by such vaccines varies, depending on the pathogenesis of the disease amongst other factors. *E.coli* vaccines include the most important fimbrial agents plus inactivated thermo-labile toxin. These vaccines can prevent neonatal diarrhoea but they do not work so well against diarrhoea present after the first week, since to do so IgA are needed in the intestine, which a vaccine administered parenterally will not produce. Porcine *Clostridium perfringens* vaccines will just work against type C, which is the one producing toxin ß responsible for the intestinal damage and included in the vaccine as toxoid. Atrophic Rhinitis vaccines will protect pigs from suffering the clinical disease; we know today that in the pathogenesis of the disease the dermonecrotic toxins produced by both *B. brochiseptica* and *P. multocida* type D play a crucial role. The best vaccines on the market will include toxoids from dermonecrotic toxins apart from other bacteria somatic antigens to develop a good protection, but they will not eliminate responsible bacteria. Auto-vaccines against *Actinobacillus pleuropneumoniae* are whole cell bacterins. They can help to reduce losses when infection is due to the same strain, but they will not develop heterologous protection against other strains. However heterologous protection can be achieved when the vaccine contains toxoid from ApxI, ApxI and ApxIII which are the toxins involved in the lung damage produced when pigs suffer from this infection. Unfortunately however Actinobacillus pleuropneumoniae vaccines are not so powerful and the reason is that they do not include the agents responsible for the adhesion of the bacteria to the epithelial cells of the lung. It is known today that when bacteria are adhered to the cells they will produce toxins directly to them avoiding in this way being neutralized by toxin antibodies (Haesebrouck, F. 2004).

Which animals should receive the vaccine and when?

To prevent those diseases which affect reproduction, vaccines have to be administered to the sows, taking into account that immunity has to be developed before clinical signs can appear. This is the case with vaccination against Aujeszky's Disease, Parvovirosis, Erysipelas or PRRS, gilts will be vaccinated twice before first mating, and against PRRS the combination of a live and inactivated vaccine would probably be the best approach as we have said before. It is important to avoid administering the vaccines too close to the mating time as reproduction can be negatively influenced. The best vaccination protocol for multiparous sows would be whole herd vaccination at different times a year (3 times a year is recommended for Aujeszky's Disease vaccine). This will avoid creating subpopulations in the herd which are not very well protected.

Sows will also be vaccinated against those diseases which affect piglets early on in their life. This is the case with E.coli, Clostridium perfringens or Atrophic Rhinitis.

These vaccines have to be administered to sows in the last part of gestation to assure maximum maternal derived immunity in piglets and revaccination will also be necessary in first gestation sows. Vaccinating sows too close to the farrowing process will sometimes result in premature farrowing, increasing the risk of pre-weaning mortality and also the risk of piglets receiving less maternal immunity (Martineau, GP. 2009).

In those particular herds endemic for *M.hyopneumoniae* or *A. Pleuropneumoniae*, vaccination of new incoming gilts will be recommended when they come from negative sources (Ridremont B., 2006).

To protect pigs produced on a farm against *M.hyopneumoniae, L.intracellularis, Erysipelothirx rhusiopathiae, H. parasuis*, Classical Swine Fever, Foot and Mouth disease, PCV2 or *A. pleuropneumoniae* amongst others, piglets or weaners will have to be vaccinated. Vaccination time will depend on the properties of the vaccination to develop immunity in the presence of maternal derived antibodies (MDA). There are some vaccines such as *L. intracellularis* or some *M. hyopneumoniae* that can be applied in lactating piglets, as they will be little or not affected by maternal derived antibodies. While others such as *Aujeszky's Disease, Erysipelothirx rhusiopathiae, H. parasuis*, Clasical Swine Fever, Foot and Mouth disease, PCV2 or *A. pleuropneumoniae* will have to be applied later on as maternal antibodies can affect vaccination. The time of vaccination will not be the same for all animals as it will depend on MDA duration, which can vary depending on the disease, farm and type of production. As an example vaccination against A. pleuropneumoniae has to be applied in some cases not earlier than 8-10 weeks or the Aujeszky's Disease vaccine will be applied at 10 and 13 weeks of age. Aujeszky's Disease MDA can be avoided if an intranasal vaccination is administered to piglets; this has been a popular practice to reduce the risk of getting the infection in those dense pig areas where the disease is endemic, as there will be no immunity window to give the wild virus the chance to infect. When MDA could represent a risk to vaccine efficiency, a double dose vaccination would be recommended. When a vaccination procedure is doubtful, a double vaccination will also reduce the risk of leaving animals without the right dose. Stress or other diseases present in the herd will also affect the vaccine's efficacy therefore having vaccination coincide with these situations should be avoided (Loula, TJ, 2010)

Conclusions

Designing a vaccination programme is not easy. It requires a good knowledge of the health situation in the country and area, as well as a good knowledge of the farm in terms of: biosecurity, pig flows, hygiene standards, facilities, management procedures and, of course, health status. It will depend also on the products available, their efficiency to control disease and the properties of the product in terms of MDA influence, onset of immunity, need for a booster vaccination, etc. However we cannot forget that pig production is a business and money will influence most of the decision making processes. The designing of vaccination programmes will not be different and therefore the cost of vaccines will also have to be taken into consideration.

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NOTES

NOTES

Oral presentations

Long duration of farrowing affects fertility of sows

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Failure to get sows pregnant within a short time after weaning is still a major cause of economic loss in modern swine production. Many factors can be responsible of rebreeding in sows. Very little research is available on factors happening during farrowing, and which could be their effect on the subsequent fertility. Our aim was to explore if parity, piglets born alive, piglets stillborn, body condition, duration of farrowing and weaned piglets are associated with the fertility of the sows at the following breeding in a farm with 440 sows (Yorkshire x Landrace). We recorded farrowings with video cameras, the beginning and the end of parturition were established by reviewing the recordings. Sows (n=93) were of parity 4.7±1.9 and their average back fat 3 weeks prior and at farrowing was 15.5±4.2 mm and 14.3±3.6, respectively. The sows had 11.9±3.2 piglets born alive, 1.0±1.6 stillborn and 9.7±1.5 weaned. The mean duration of farrowing was 283±157 minutes. After weaning, 11 % of the sows failed to get pregnant at the first insemination (n=10). This percentage is in accordance with the historical reproductive performances of this herd. A logistic regression model was used in order to find significant predictors between rebred sows and successfully pregnant sows. The mean duration of farrowing in the rebred sows was 434±259 minutes, while in the pregnant sows it was 264±144 minutes ($P < 0.01$). No significant differences were found in the other parameters observed. In conclusion, longer duration of farrowing significantly increased the risk of rebreeding.

Increased quantitative excretion of Lawsonia intracellularis is associated with decreased average daily gain in weaned pigs

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Introduction

The objective was to investigate association between average daily gain (ADG) and quantitative faecal excretion of Lawsonia intracellularis (LI) in weaned pigs.

Material and Methods

A longitudinal study (n=166 pigs) was performed in a Danish herd from day 30 to 48 post weaning (mean weight at day 1 = 15.7 kg, standard deviation = 2.7 kg.). Every third day all pigs were weighed, subjected to a clinical examination and faecal samples were obtained. All faecal samples were subjected to dry matter determination (1). Retrospectively, 49 pigs with and 49 pigs without diarrhoea were selected for LI qPCR testing at day 1 and 19. The selected pigs were matched according to start-weight, gender and pen.
Association between ADG and quantitative excretion of LI (log10 cells /g faeces; average excretion of day 1 and day 19) were investigated in a linear mixed model, including pen, gender and start-weight.

Results

A 1 log10-unit increase in the average LI excretion was associated with a 56 g decrease in ADG ($p<0.0001$) in both pigs with and without diarrhoea, figure 1.

Discussion

The results of this preliminary study suggested that quantitative measurement of faecal LI excretion can be applied as a tool for assessment of economic effect of LI infection. Interestingly the association between LI and ADG seemed to be independent of development of diarrhoea based on examinations performed every third day.

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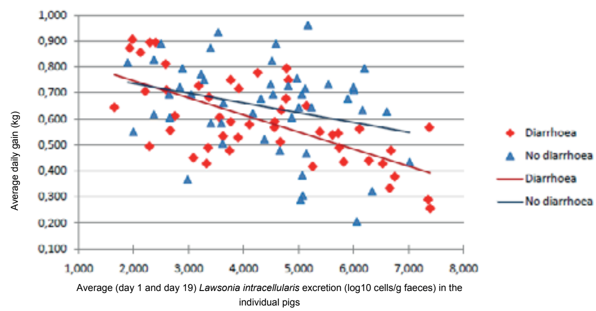
Figure 1. Association between *Lawsonia intracellularis* excretion and average daily gain in 19 days



Efficacy of chlortetracycline against a clinical outbreak of respiratory disease in fattening pigs

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The efficacy of chlortetracycline in feed medication to treat pigs with clinical respiratory disease (RD) was determined. The study was conducted in a farrow-to-finish pig herd infected with M. hyopneumoniae and with clinical RD in growing pigs. In total, 353 pigs were included. They were vaccinated once against M. hyopneumoniae and PCV2 at weaning. At 14 weeks of age (D0), at onset of clinical RD, they were randomly allocated to one of the following treatment groups: chlortetracycline(CTC)(14 days, n=180) or tylosin(T)(21 days, n=173). Clinical parameters (respiratory disease score RDS), performance and lung lesions at slaughter were assessed. The % of pigs coughing per pen during 5 minutes was assessed twice per week. Daily weight gain (DWG), feed conversion ratio (FCR) and mortality were measured during D0-D21. Therefore, all pigs were weighted individually at D0 and D21, and the total feed consumed per pen was assessed. Pneumonia and pleuritis lesions were assessed at slaughter (CTC=52, T=59). Data were analysed using univariate ANOVA (RDS and DWG, FCR), Kruskal-Wallis test (DWG) and Chi-square test (mortality and lung lesions). The average (±SD)RDS, DWG, FCR and mortality during D0-D21 in groups CTC and T were: CTC=13.36±4.38, T=13.96±6.37 (P=0.788); CTC=0.542±0.015, T=0.517±0.024, (P=0.902); CTC=2.59±0.17, T=2.57±0.22, (P=0.948) and CTC=0, T=5, (P=0.022), respectively. The % of pigs with pneumonia and pleuritis lesions at slaughter was [CTC=80.8, T=84.7, (P=0.579)] and [CTC=9.6, T=15.3, (P=0.372)], respectively. The study showed a similar effect on performance for both medication protocols and a slight improvement of clinical parameters, being mortality statistically different in CTC protocol.

Effect of PCV2 maternally derived antibodies on serum viral load in postweaning multisystemic wasting syndrome affected farms

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The present study aimed to assess the effect of PCV2 maternally derived antibodies (MDA) on postweaning PCV2 serum viral load dynamics and average daily gain (ADG) in postweaning multisystemic wasting syndrome (PMWS) affected farms. Thus, 117 sows from 2 different farms (Farm A=58 sows; Farm B= 59) were bled one week before farrowing. One to two pigs per sow were selected (Farm A=88 pigs; Farm B= 85), which were bled at 3, 9, 15 and 21 weeks of age and weighted at 3 and 21 weeks of age. Sera from sows and 3 week old pigs were tested for PCV2 antibodies by means of an immunoperoxidase monolayer assay (IPMA) technique. A standard PCV2 PCR was performed in all sow and pig serum samples, and those that tested positive were also analyzed by means of real time quantitative PCR (qPCR). Area under the curve of qPCR (AUCqPCR) and ADG from 3 to 21 weeks of age were assessed. Relationships among variables were assessed by means of Spearman's Rank correlation analyses. All sow serum samples tested negative to standard PCR. IPMA antibody titres from sows and pigs at 3 weeks of age were positively correlated (Þ=0.433; $p<0.001$). Moreover,lower IPMA antibody titres in both sows (Þ=-0.234; $p=0.002$) and 3 week old pigs (Þ=-0.331; $p<0.001$) were correlated with a higher AUCqPCR. However, despite a negative correlation between AUCqPCR and ADG was found (Þ=-0.261; $p<0.001$), IPMA antibody titres from sows or 3 week old pigs were not associated with ADG.

Differencies in growth reduction in finishing pigs with diarrhea

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Introduction

The objective of this study was to estimate the effect of diarrhea on average daily gain in grower-finisher pigs in 5 herds with diar-rhea.

Materials and Methods

A prospective cohort study was carried out in 5 herds with a history of diarrhea and seroconversion to Lawsonia intracellularis in the grower-finisher pigs. In each herd 60 pigs from four pens were ear tagged. The pigs were weighed at the beginning of the study and at the end of the 6–8 weeks observation period. No routine flock medication against diarrhea was used. Blood and fecal sam-ples from each pig were collected with two weeks interval. Fecal score was assessed visually. Diarrhea was defined as fluid fecal score. At the end of the observation period 5 slow growing pigs and 5 fast growing pigs from each herd were eutha-nized and selected for laboratory examination. The selected pigs were tested for Lawsonia antibodies by Elisa (1), presence of Lawsonia in feces by q-PCR (2), and Lawsonia in the intestine by immunohistochemistry (IHC)(3) .

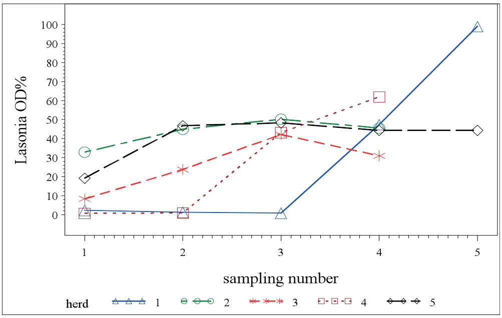
The impact of diarrhea on average daily gain was estimated in a linear regression model with pen and start weight as covariates in each herd.

Results

An active Lawsonia infection was seen in herds 1, 3, and 4 (Figure 1+2). In the same herds Lawsonia was detected by ICH, and the highest Lawsonia load in feaces, and the highest reduction of ADG was observed. The results indicate that the impact of diar-rhea on ADG is dependent of an active Lawsonia infection in the herd.

Table 1. Estimated negative effect of fluid diarrhea on average daily gain in all pigs during grower finisher period in 5 herds, Law-sonia in intestine detected by immuhistochemistry, and average maximum Lawsonia load in faeces in the killed pigs

Herd	Number of pigs included in the analysis	Proportion of pigs with diarrhea %	ADG in pigs without diarrhoea, g/day	Estimate of reduction in ADG, g/day due to diar-rhoea	95% CI	P-value	Lawsonia in intestine by immunohisto-chemistry, pos/total	Average maxi-mum Lawsonia load in faeces, log10/g faeces
1	48	10.4	996	155	67-244	0.001	9/10	5.2
2	60	5.0	557	42	-107-191	0.57	0/10	1.1
3	60	8.3	782	371	185-557	0.0002	2/10	4.9
4	58	27.6	777	207	90-324	0.0009	11/11	6.0
5	57	5.3	970	67	-79-215	0.36	0/10	3.8



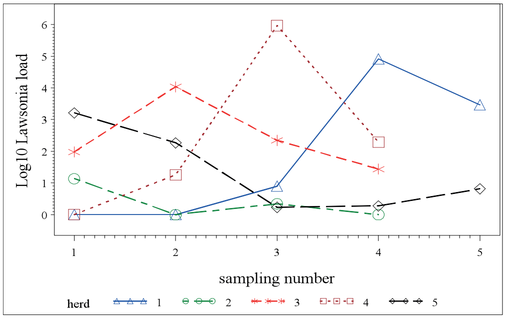


Figure 1. Average level of antibodies in serum against Lawsonia, OD % in 5 herds (the killed pigs)
Figure 2. Average Lawsonia load in faeces in 5 herds (the killed pigs)

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Ethical, environmental and economical aspects on health status of pigs

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Pigs in Sweden are healthy and perform well. Annually, 136,400 sows rear 22 pigs to market weight (three million fatteners). Still, losses due to suboptimal production are substantial. Mortality from birth to weaning (17%) causes annual losses of 5.9 million €. Mortality postweaning (2.3%) and during fattening (2.4%) another 8.9 million €, and reproduction failures 1.4 million €.

The average age at slaughter (118 kg) is 181 days. SPF pigs reach market weight at 141 days, reducing rearing costs with 28€ per pig (daily cost for a fattening pig is 0.7 €). Vaccinations costs ranged from 9 to 60 € per sow in conventional herds (5 € in the SPF herd). The SPF herd annually treated 4 kg pig per sow with antimicrobials at a cost of 1 €. Conventional herds treated 0-1639 kg (0-29 €).

The total annual cost for suboptimal production corresponded to 120 million € per year (875 € per sow), while the mean net profit (slaughter income – rearing costs for the offspring) from each sow was 677 €. The net profit per sow in the top herds was 891 €, and 1,355 € in the SPF herd.

If one extra pig could be reared to market weight from each litter, the annual production would increase with 300,000 pigs (10%). Healthy animals are environmentally friendly. Swedish pigs consume 4,500 tonnes of feed/day, annually loading the environment with 5,000 tonnes of nitrogen. Any improvement of the feed utilisation with 1% will reduce that loading with 65 tonnes.

Table. Productivity in an SPF herd and in conventional pig herds

		SPF	**PigWin Control prograsm, 2009**		
Annual production per sow		**Sero**	**Best 25%**	**Mean**	**Last 25%**
Stillborn piglets	(n)	3,7	2,0	2,2	2,4
Piglets born alive	(n)	29,7	29,2	27,0	22,9
Weaned piglets	(n)	25,2	25,4	23,0	19,0
At allocation (30 kg)	(n)	25,2	25,0	22,5	18,7
Slaughtered pigs	**(n)**	**25,1**	**24,5**	**22,0**	**18,1**
Age at 30 kg bw	(days)	70	80	83	86
30 kg – market weight	(days)	71	91	98	106
Birth to market weight	**(days)**	**141**	**171**	**181**	**192**
Mortality					
Preweaning	(%)	15,5	14,8	17,0	20,7
Postweaning	(%)	0,1	1,6	2,3	3,6
During fattening period	(%)	0,5	1,8	2,4	3,2
Sows (estimated)	(%)	0,2	1,0	2,0	3,0
Reproduction					
Repeat breeding	(%)	8,0	6,0	8,3	10,2
Abortions	(%)	0,2	1,0	1,5	2,0

Economical Analysis of PRRSv-Outbreaks of in Nine Sow Herds.

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Introduction

After the first recognition of Porcine Reproductive and Respiratory Syndrome virus (PRRSv) in 1987, nowadays PRRSv is endemic in most pig-producing countries, including the Netherlands.

The epidemic phase of the disease presents itself by massive reproductive failure during the last month of gestation. (Collins et al. 1991) and the economic losses of PRRS are considered to be huge (Holck 2003). The aim of this study was to quantify the economical effects of an outbreak of PRRSv.

Materials en methods

Nine breeding herds were selected based on a confirmed PRRSv outbreak. The economical impact during the outbreak (18 weeks) was calculated from the reduced technical results and other costs (medication, diagnostics, labour etc.) compared to 26 weeks preceding the outbreak. We also calculated the costs after the outbreak, e.g. costs to eradicate the disease..

Results and Discussion

The economical impact varied between €59 and €329 per sow per eighteen-week period outbreak (Table 1). The two nucleus production herds had the biggest losses per sow per outbreak, with an average loss of €305 per sow during the period of outbreak (herd numbers 2 and 8, Table 1). The average loss in a regular sow herd was €75 per sow per outbreak. An overall loss per sow per outbreak was €126.

The costs after the outbreak, varied greatly from €3 to €160 per sow, due to the variety in decisions of farmers to eradicate PRRSv or just stabilize the herd.

The calculated costs in this study are in line with the costs of the initial outbreak in the Netherlands (€98/sow, Brouwer et al, 1994).

Herd	Type of herd *	# sows	No. of piglets born alive/litter Absolute change	Pre-weaning mortality rate (%) Absolute change	Post-weaning mortality rate (%) Absolute change	Farrowing-index Absolute change	No. of sold feeder pigs Percentile change	Total loss (€)	Loss/sow (€)	Loss/sow after the outbreak (€)
1	M	375	-1.39	+2.1	+0.8	-0.05	-15,5%	31,522	83	5
2	B	250	-1.62	+16.5	+3.5	-0.12	-38.6%	95,725	379	164
3	M	275	-0.20	+6.6	+3.1	-0.01	-12.5%	33,523	85	16
4	B/M	440	-0.20	+3.6	+2.1	+0.07	-4.7%	27,853	59	60
5	M	385	-1.10	+3.0	+2.1	-0.19	-20.2%	35,040	81	5
6	M	360	-1.38	+3.6	+1.7	+0.05	-14.4%	26,084	61	3
7	M	1175	-0.67	+1.9	+1.1	-0.26	-19.2%	105,854	90	3
8	B	585	-1.50	+4.5	+1.5	-0.04	-20.8%	134,292	230	66
9	M	1075	-0.50	+3.7	==	-0.19	-15.9%	68,293	64	5

Table 1. Losses during and after the period of outbreak.
* M=Multiplier, B=Breeder

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Persistence of methicillin resistant Staphylococcus aureus (MRSA) after cleaning and disinfection procedures in pig holdings

Giuseppe Merialdi[1], Elena Galletti[1], Carlo Rosignoli[1], Giovanni Alborali[1], Enrico Giacomini[1], Antonio Battisti[2], Giulio Granito[3], Antonella Mazzaro[1], Paolo Martelli[4], Istituto Zooprofilattico Sperimentale della Lombardia e dell'Emilia Romagna Istituto Zooprofilattico Sperimentale Lazio e Toscana Veterinary practitioner Parma University

This study was carried out to evaluate the persistence of MRSA in the environment of colonized herds before and after cleaning and disinfection.
Six colonized herds applying all in all out at least in farrowing and weaning units were included. Environmental samples were collected from farrowing, weaning, growing and finishing units. Ten dust samples/unit were taken by using sterile dry swabs (Sodibox®) before (in the presence of animals, at the end of the productive phase) and after cleaning and disinfection. All samples were cultured for MRSA.

In populated farrowing crates 5 of 6 herds were contaminated (percentage of positive dust samples ranging from 30% to 100%). Only one herd showed residual MRSA contamination in farrowing crates after cleaning and disinfection (1 positive out of 10).

Environmental contamination in populated weaning units was recorded in 5 out of 6 holdings (range 20%-100%); 3 holdings resulted contaminated after cleaning and disinfection (range 30%-100%).
In populated growing units all herds were contaminated (range 20%-90%) and 5 after cleaning and disinfection (20%-70%).
Populated finishing barns resulted contaminated in all holdings (range 10-90%). The environmental contamination persisted after cleaning in 4 out of 6 (range10%-20%).

The overall proportion of positive samples in populated units and after cleaning and disinfection were 50 and 19%, respectively.
The study suggests that, although current cleaning and disinfection procedures are likely to be inadequate to completely eliminate MRSA environmental contamination, the more these operations are strict (as in farrowing crates) the more a significant reduction can be achieved.

Poster presentations

FIRST ISOLATION OF Actinobacillus pleuropneumoniae IN PIGS IN ISRAEL

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Paper illustrates first isolation of A. pleuropneumoniae in Israel.
Farm: 1200 sows close-cycle; acute respiratory cases; mortality up to 8%; lesions at necropsies suggestive of A. pleuropneumoniae.
Lungs samples from different episodes sent to a local laboratory, for isolation and sensitivity tests.
Culture: on MacConkey agar, 5% sheep blood trypticase agar, and on Chocolate agar (with both X and V factors). Isolates obtained from Chocolate agar only after 24 hours incubation at 37ºC, aerobic conditions. Isolates inoculated on 5% sheep blood trypticase agar with Staphyloccocus aureus streak then incubated 24 hours at 37ºC, aerobic conditions
Isolation validation: colonies streaked on Chocolate agar with 1% blood –agar; incubated 24 hours at 37° C; 3 replicates forwarded to Animal Health Institute "IZSLER", Brescia, (Italy).
Serology: 30 frozen blood sera sent to Intervet International Laboratory, Boxmeer (The Netherland) for serological investigations towards respiratory antigens and towards Apx I, Apx II, Apx III, OMP antigens with an "in house" antibody-ELISA test.
Typization: 3 isolated strains replications submitted to Ring Precipitation Test, on rabbit antisera – antigen reaction.

Laboratories investigations confirmed A. pleuropneumoniae:
Culture: no growth on MacConkey or Blood agar. Colonies on Chocolate agar plates appeared coccobacilli Gram negative, with satellitism to S. aureus. Colonies on Blood agar showed beta haemolysis. Satellism to S. aureus is indicative of App bio-variant 1, NAD dependent.
Biochemical tests and CAMP phenomenon confirmed A. pleuropneumoniae strains'identity
Typization: RPT and PCR tests confirmed isolates belong to A. pleuropneumoniae sero-type 13.
Serology: all 30 samples resulted positive to A. pleuropneumoniae antigens.

Influence of simultaneous use of Porcilis® M Hyo and Porcilis® PRRS on clinical performance and lung lesions

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Introduction

Several studies have shown the interaction of PRRSV and Mycoplasma hyopneumoniae (M. hyo) in causing respiratory diseases in combination with lung lesions (1). This study investigated the simultaneous use of Porcilis M Hyo and Porcilis PRRS with regard to clinical performance and lung lesions.

Materials & Methods

The blinded field trial took place on a piglet producing farm and a wean-to-finish farm in Austria, with respiratory problems associated with M. hyo and PRRSV. One thousand one week old suckling piglets were divided into five groups, which were either non vaccinated or vaccinated against M. hyo and/or PRRSV (table 1). The body weight was evaluated at four times (table 2) and clinical examinations were performed weekly. Individual lung scoring (2) was conducted for all animals at the slaughterhouse.

Table 1: Vaccination of the different groups
* Concurrent use: vaccines are given at the same time, but at different sites.
** Simultaneous use: lyophilised Porcilis PRRS dissolved in Porcilis M Hyo is given in one injection at one site.

Group	Product:	1st week	3rd week
A	Porcilis PRRS		X
B	Porcilis M Hyo	X	X
C	Diluvac Forte (Placebo)	X	X
D	Porcilis PRRS		X*
	Porcilis M Hyo	X	X*
E	Porcilis PRRS		X**
	Porcilis M Hyo	X	

Table 2: Mean ± standard deviation of the average daily weight gain in gram/day. No significant differences were detected between the study groups.

Group	Nursery period	Fattening period	Weaning to last weighing
A	412 ±63.30	836 ±87.72	655 ±56.76
B	407 ±63.82	831 ±92.30	649 ±60.15
C	416 ±69.61	838 ±98.08	656 ±62.44
D	409 ±70.87	833 ±97.57	**651 ±63.94**
E	**413 ±67.73**	**827 ±101.56**	**650 ±64.19**

Results

Significant differences could only be observed in the lung lesion score of the affected lungs from the different groups (figure 1). The scores from all three Porcilis M Hyo vaccinated groups were lower than the scores from the non Porcilis M Hyo vaccinated groups.

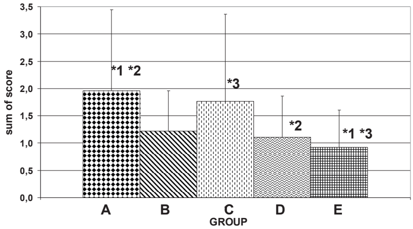

Figure 1: Mean +standard deviation of the severity code of affected lungs from the different treatment groups.
*1 p=0.006 (A:E), *2 p=0.02 (A:D),
*3 p=0.022(C:E)

Discussion & Conclusions

The lungs from pigs which received the simultaneous use vaccination suffered the least from the infection with M. hyo. These results are supported by previous laboratory studies (3). Since no significant differences in clinical signs and ADWG could be detected, it can be assumed that the infectious pressure of PRRSV and M. hyo was not high on this farm. Even though, significant differences in lung lesions could be observed. A higher infectious pressure might have resulted in significant differences in ADWG as well.

Acknowlegements

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FUGATO-RePoRI: Functional and positional analyses for the identification of candidate genes for resistance to Actinobacillus pleuropneumoniae (APP) in swine

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A. pleuropneumoniae is among the economically most important pathogens of the respiratory tract in swine. Using pigs with a higher resistance to the pathogen might be an important part of future prophylaxis, to improve economy, animal welfare and concumer protection. Preliminary studies provide evidence for relative differences in resistance/susceptibility within and between pig breeds. Transcriptomic analyses identified several hundreds of differentially expressed, functional candidate genes. Aiming towards essential candidate genes to be used as markers in commercial breeding programs and to improve our knowledge on disease and pathogenesis, we have set up an experiment that combines functional and positional analyses. F2-families were produced from relatively resistant Hampshire (HA) and relatively susceptible German Landrace (DL) populations. 170 F2 pigs were challenged and phenotyped based on exactly standardised procedures, allowing minimal environmental effects.

Expression data from lung tissues of the 50 most and the 50 least susceptible pigs were generated with a 24k whole genome Affymetrix microarray. All pigs were genotyped on a genomic basis and phenotypes and genotypes were associated to map quantitative trait loci (QTL). QTL-analysis resulted in 30 significant clinical QTL, concentrating on 8 chromosomes. Expression of almost 90% of the differentially expressed genes was regulated by genes on other chromosomes (trans), showing the reduced power of solitary functional studies. Hotspots of gene regulation regarding A. pleuropneumoniae resistance were mapped to chromosomes 2, 13 und 18 . Our investigation confirms the genetic basis of A. pleuropneumoniae resistance in swine. The results provide valuable information on pleuropneumonia pathogenesis and resistance.

Optimization of qPCR according to MIQE guidelines for pro-inflammatory cytokines in PRRSv experimentally infected pigs

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Introduction.

Normally quantitative PCR (qPCR) generates lots accumulative errors, which can induce to imperfect interpretation of results. Following the MIQE guidelines the researches can obtain data that are more uniform, comparable and reliable. The aim of the present study was to evaluate qPCR efficiency parameters for different pig proinflammatory cytokines. Cytokine expression has already been observed in lung, whereas no significant increases have been observed in blood.

Materials and methods.

mRNA from tonsils of several PRRSV-positive pigs was extracted and purified. cDNA was obtained by means of a retrotranscriptase-PCR, and it was used as template for classic PCR. Integrating cDNA in plasmid was quantified. Replicates of medium and decimals dilutions qPCR for proinflammatory cytokines (IL-12A, IL-12B, IFN-a and IFN-y), were made, using SYBR-Green. Finally, the efficiency, coefficient of variation and discrimination factor were calculated for each qPCR.

Results.

Results are shown in Table 1.

Discussion.

The reproducibility (CV) of the qPCRs tested is good. The capacity of differentiate different numbers of cDNA copies (FD) is good for all the qPCR tested. The discrimination factor indicates that these qPCR differentiate small gene expressions changes along the dynamic range. It should be considered the quantification error, especially in both IFNs and TNF-a. It can be concluded that these qPCR can be used to measure gene expression differences of proinflammatory cytokines between different pigs, considering that calculation of PCR efficiency should be done in order to normalize qPCR for gene expression.

	Medium Values				
	IFN-α	IFN-γ	IL-12A	IL-12B	TNF-α
Medium efficiency	0,83260752	0,83049001	0,88258765	0,8785685	0,8309713
CV médium (%)	2,54066214	1,47217833	2,50670741	4,10755429	1,48753013
FD medium	2,7299373	1,67257442	2,09805614	3,20037883	1,50959943

Table 1. qPCR medium values for medium and decimals dilutions.

Optimization of qPCR according to MIQE guidelines for immunomodulatory cytokines in PRRSv experimentally infected pigs.

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Introduction.

Not optimized quantitative PCR (qPCR) generates lots accumulative errors, which can induce to imperfect interpretation of results. Following the MIQE guidelines the researches can obtain data that are more uniform, comparable and reliable. Some isolates of PRRSV have been proved to induce an upregulation of IL-10, but so far few studies have been focused on the role of TGFß. It would be interesting to decipher the ability of different PRRSV isolates to induce the expression of immunomodulatory cytokines, which may interfere with the synthesis of interferons, and therefore the ability to control viral replication. The aim of the present study was to evaluate qPCR parameters for gene expression of pig immunomodulatory cytokines.

Materials and methods.

mRNA from tonsils of several PRRSV-positive pigs was extracted and purified. cDNA was obtained by means of a retrotranscriptase-PCR, and it was used as template for classic PCR. cDNA was cloned into a plasmid and quantified. Replicates of medium and decimals template dilutions for immunomodulatory cytokines (IL-10 and TGF-ß) were made. DNA amplification was detected with SYBR-Green chemistry. Efficiency, coefficient of variation and discrimination factor were calculated for each qPCR.

Results.

Results are shown in Table 1.

	Medium Values	
	IL-10	TGF-β
Efficiency	1,144159635	0,818047775
CV medium	1,529732887	2,361333821
DF medium	2,226282253	1,63307194

Table 1 qPCR medium values for medium and decimals dilutions.

Discussion.

Both qPCRs show high reproducibility (CV). The capacity of differentiate different numbers of cDNA copies (FD) is high in qPCRs tested, so that can distinguish slight variations in gene expression. In conclusion these qPCR are suitable for assessing gene expression of immunomodulatory cytokines differences among pigs, but to normalize gene expression it should be used the efficiency calculate for each qPCR.

Differential diagnosis of coughing in Mycoplasma hyopneumoniae vaccinated finisher pigs – A case report

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Aim

To identify the cause of respiratory disease in pigs vaccinated twice against Mycoplasma hyopneumoniae (Mhp).

Materials and methods

On a 1200-head finisher farm respiratory disease was observed, with coughing as main clinical sign. Pigs were vaccinated twice against Mhp. No other vaccine was given.
Lung examinations and serological investigations were performed.

Results

Results are summarized in table 1 and 2. Results show that pigs were infected with PCV2, PRRSv EU, Mhp and two strains of SIV.

Table 1 Results from laboratory testing (5 pigs).

Pathogen	Laboratory result
PCV2 by PCR – log virus copies per ml	**6,84**
PRRS EU/US – ELISA	**Positive EU**
PRRS EU – IPMA	**250-1250**
PRRS US – IPMA	**0-250**
App type 2 – ELISA	Negative
Influenza H1N1 – HI	**Positive 5/5**
Influenza H1N2 – HI	**Positive 3/5**
Influenza H3N2 – HI	Negative
Mhp – ELISA	**Positive 5/5**

Table 2. Lung examination.

Number of pigs examined (lungs and heart)	66
Pigs with no lesions	42 %
Pigs with small areas of scar tissue in lungs	10,6 %
Pigs with catarrhal pneumonia (”mycoplasmalike” pneumonia)	18,2 %
Pigs with chronic pleurisy	19,7 %
Pigs with pleurisy above 10 % of lung surface	10,6 %
Pigs with chronic pericarditis	19,6 %
Proportion of lung affected with catarrhal pneumonia (in affected lungs)	10,3 %
Proportion of lung affected with chataral pneumonia (in all lungs)	1,9 %

Discussion

Multiple pathogens were identified, including PCV2, PRRSv-EU and SIV. Against none of these pigs had been vaccinated. The serological response to Mhp is commonly seen in vaccinated pigs from infected farms. It reflects presence of Mhp, but not that it is responsible for disease.
The extent of “Mycoplasma-like” lesions is low. They might be caused by Mhp, but SIV causes very similar lesions that cannot be differentiated macroscopically. Another finding was a very high prevalence of pleurisy and especially pericarditis. These lesions are not caused by Mhp infection, but can explain the persistent coughing observed, since cardiac insufficiency will cause oedema in lungs and subsequent coughing. The findings are most pro-bably related to the impact of several virus infections clearing way for secondary bacterial infections. Haemophilus parasuis, Strep. suis and/or Mycoplasma hyorhinis are possible causative agents.
Based on the diagnostic findings, it can be conclu-ded that the clinical disease was caused by several respiratory pathogens. This case report demonstrates the importance of thorough differential diagnostics in cases of respiratory disease.

IL-10, IL-12, IFN-γ and IFN-α immunohistochemical expression in lymphoid organs of porcine reproductive and respiratory syndrome virus-infected pigs

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Introduction

Porcine Reproductive and Respiratory Syndrome (PRRS) is characterized by an impaired host immune response, however, several studies are being carried out to decipher the mechanisms used by PRRS virus (PRRSV). The aim of this study was to determine the expression of IL-10, IL-12, IFN-y and IFN-a in lymphoid organs of PRRSV-infected pigs.

Materials and methods

Twenty eight, PRRSV-negative pigs were inoculated with PRRSV field isolate 2982 and killed in groups of four animals at 3, 7, 10, 14, 17, 21 and 24 days post-inoculation (dpi). Control animals were mock-inoculated and killed at the end of the study. Samples from mediastinal and retropharyngeal lymph nodes and tonsil were fixed in Bouin solution for immunohistochemical study. The primary antibodies were used as previously described (Gómez-Laguna et al., 2010).

Results

PRRSV antigen was mainly detected in the cytoplasm of macrophages, displaying a bimodal expression with a first peak at 3-7 dpi and a second peak at 14 dpi. The expression of IFN-a showed an early enhancement at 3 dpi, and both IL-12 and IFN-y displayed a similar trend in all the lymphoid organs analysed, showing an increase at 3-7 dpi and at 14-17 dpi. On the other hand, the expression of IL-10 was milder than the one observed for the other cytokines.

Discussion

The milder expression of IL-10 compared with the higher expression of IL-12, IFN-a and IFN-y detected in this study, points to a possible but not unique role of IL-10 in the inducement of an equivocal host immune response. Taking into account the elevated expression of IFNs observed in lymphoid organs, further studies are being conducted to determine if there is a down-regulation in IFN signaling pathway.

Update on the monitoring of pleural lesions at slaughterhouse using the S.P.E.S. grid in Italian slaughtered pigs

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From February 2008 to January 2011 lungs from 14195 pigs belonging to 139 batches were evaluated using the Slaughterhouse Pleurisy Evaluation System (S.P.E.S.). Using the SPES grid, a score ranging from 0 to 4 is assigned to each lung depending on the extension and location of pleural adherences. Two outputs for each batch are provided: the SPES average value and the App Index (APPI) giving information on the prevalence and the severity of dorso-caudal pleuritis (scores 2,3 and 4) highly suggestive of pleuoropneumonia due to Actinobacillus pleuropneumoniae (App) (Dottori et al., 2007; Merialdi et al., 2008). 42.0% of the lungs showed chronic pleuritis (SPES score ≥ 1). Dorso-caudal pleuritis (SPES score ≥ 2) was found in 24% of the lungs. Lesions with score 2 were assessed in 14.3% and lesions scoring 3 and 4 were present in 8.3% and 1.6% of pigs, respectively. The mean SPES value of the overall lungs was 0.77. The mean APPI of all batches was 0.60. The APPI values were organized in four classes : best quarter < 0.28; intermediate best quarter from 0.28 to 0.53; intermediate worst quarter from 0.53 to 0.81 and worst quarter > 0.81. This study confirms the high prevalence of dorso-caudal pleuritis in Italy, approximately twice when compared to the data obtained in Spain by Fraile et al. (2010) using the same scoring system. The distribution in classes of APPI values obtained in this study can be used as a tool for ranking a batch in respect of the general population.

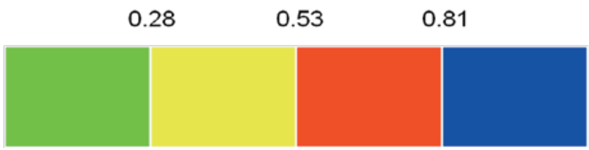

Fig.1: Distribution of APPI values in four classes: APPI < 0.28 (best quarter); APPI from 0.28 to 0.53 (intermediate best quarter);
APPI from 0.53 to 0.81 (intermediate worst quarter); APPI > 0.81 (worst quarter).

SEROPREVALENCE OF H1N1, H3N2 AND H1N2 INFLUENZA VIRUS IN PIG FARMS AFFECTED BY RESPIRATORY DISORDERS IN ITALY IN 2009

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Introduction

The objective of the study was to evaluate the seroprevalence of SIVs in farms affected with acute respiratory clinical signs in Italy.

Materials and methods

Farms were chosen because they faced acute respiratory clinical signs in pigs at least 3 weeks before sampling in the absence of prior vaccination against SIV.

Table 1: Farms and samples characteristics

Investigated farm type	N°	Samples in each farm from May to December 2009
Farrow-to-finish farm	16	10 sows 10 fattening pigs before slaughter
Fattening farm	4	20 pigs before slaughter
Multi-site herds	5	20 samples were performed in post weaning unit in 2 cases and in finisher units in 3 cases.
Total	**25**	**500 sera** were sent to IZSLER laboratory, Parma, Italy, to be submitted to haemagglutination inhibition tests (HI)[1]

Strains used in the HI tests:
- H1N1 A/sw/Finistere/2899/82,
- H3N2 A/sw/Gent/1/84 and
- two H1N2 strains:
  - o H1N2 A/sw/Italy/1521/98
  - o H1N2 A/swine/Italy/284922/09

Criteria of positivity for each subtype
- Positive samples : if the titre is ≥1/20;
- Positive farm : if at least 2 sera showed a HI titre ≥1/20.

Risks of misinterpretation due to cross-reactivity between H1N2 and H1N1 strains were decreased by considering negative for one antigen a serum that showed higher (3 log2) HI titre against the other.

Results and Discussion

Results and Discussion

Table 1: positive serological results by HI tests (%)

Tested strain	N° farms tested	% positive farms
H1N1 A/sw/Finistere/2899/82	25	40
H1N2 A/sw/Italy/1521/98	25	20
H1N2 A/sw/Italy/284922/09	25	56
H3N2 A/sw/Gent/1/84	25	32

76% of the tested farms were positive for at least one SIV subtype, more than 50% of farms were positive for H1N2.

Table 2: Comparison of the HI titres obtained using the two H1N2 subtype strains.

Titre	<20	20	40	80	160	320	640	Total
H1N2 sw/Italy/1521/98	483	13	3	1	0	0	0	500
H1N2 sw/Italy/284922/09	373	42	46	28	9	1	1	500

The use of updated strains (H1N2 A/swine/Italy/284922/09) adapted to the local epidemiological situation is a major asset for improving the accuracy of SIV surveillance programmes, same conclusion was observed in France1.

Co-infections with more than one subtype were shown in several farms: 32% of farms were infected with at least 2 subtypes and 20% were positive for the 3 subtypes.

Conclusion

SIV infection is enzootic in swine producing regions of Italy and the highest prevalence (>50%) was found against the H1N2 subtype.

References

1. Foni et al. (2009), Proceedings of the 2nd ESPHM, Hannover, Germany, 2010, p104

Exploratory reference data on hematology and cellular immune system of multiparous Large White sows

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Surprisingly, there is a significant lack of basic hematologic data derived by modern hematology systems and characterization of leukocyte populations and cytokine production in adult sows, although these data are of pivotal importance for routine diagnosis of infectious and other diseases. Thirty two clinically healthy multiparous Large White sows aged 33.5 ± 9.6 months and all of them one to two months post partum were included into this study. Mean erythrozyte count was 5.5 ± 0.7 x 106/µl and total leukocyte count was 12.1 ± 2.1 x 103/µl. Proportion of lymphocytes was 44.7 % and of neutrophils 41.6 %. The ratio of naïve T helper (Th) cells (CD4+CD8a-) to memory T helper cells (CD4+CD8a+) was 1:3.1 and the ratio of Th cells to cytotoxic T cells (CTLs) was 1:4.2. Proportions of regulatory T cells, natural killer cells, CD21+ B cells, and plasmacytoid dendritic cells were lower (3.1, 2.6, 6.0, and 1.6 %) than those of memory Th cells (ranging from 8.8 to 27.5 %, depending on the subpopulation) and CTLs (37.3 %). Contrary, yõ T cells were found at significantly higher numbers (19.1 %). Cytokine expression by leukocytes as measured by flow cytometry was evident at a low level with the exception of TNF-a and IFN-y with 55.6 ± 10.4 % and 26.1 ± 8.5 % positively stained peripheral blood mononuclear cells.

Impact of immunocastration on meat percentage, growth rate and feed consumption

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Three groups of immunocastrated male (IC, n=80, 77 and 72), surgically castrated male (SC, n=60, 50 and 56) and female (F, n=60 , 62 and 59) finishing pigs (group 1 and 3: Hampshire x (Landrace x Yorkshire), group 2: (Duroc x Landrace) x (Landrace x Yorkshire)) were raised on commercial farm in Finland. Pigs of same treatment group were housed in pens of 10 pigs. The liquid feed consumed by 20 pigs of same treatment group was measured daily. 3-phase feeding was used (phase 1: days 0-24, phase 2: days 25-56, phase 3: day 57-slaughter). IC pigs were vaccinated against boar taint with Improvac at 12 and 16 weeks of age and all pigs were slaughtered when they reached normal slaughter weight. Meat pergentage was measured by AutoFom .The average meat percentage was 59,28% on IC pigs and 59,67% on F pigs, these being significantly higher ($p<0,05$) than on PC pigs (58,39%). The average feed consumption was 2,88 kg of feed per 1 kg of meat produced on IC feeders (n =10), 3,02 kg on SC feeders (n =7) and 2,83 kg on F feeders (n =9). There was significant difference ($p<0,05$) in phase 2 feed consumption between IC and SC pigs. There was no significant difference in total feed consumption, slaughter weight or growth rate between treatment groups. In these data, immunocastration increased meat percentage but had no effect on total feed consumption, slaughter weight and growth rate.

Impact of vaccination of male fattening pigs with Improvac® on behavioural features

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Vaccination of male fattening pigs with Improvac® is an alternative for surgical castration of piglets in the first week of life without anaesthesia. This study analysed the impact of vaccination on behavioural features of 59 animals as compared to boars (n = 29) and surgically castrated pigs (n = 90). 10 animals per group were analysed three times per day (morning, midday, evening) starting 10 weeks before slaughter. Vaccinated pigs before the second vaccination and boars behaved very similarly with more general activity but less feed intake in contrast to castrated pigs. With aging more sexual behavioural activity such as longer lasting (> 10 sec) fights, mounting of other pigs, and mating movements occurred in the former two groups whereas castrated animals never showed any of these behavioural features. By one week after the second vaccination there was a signficant reduction in sexual behavioural activity in the respective animals. So these animals started to behave in a very similar manner as the castrated pigs. Of great interest was the dependency of the occurrence of specific behavioural features on the time point of observation. Animals were active especially in the evening and to a lesser degree during midday. In the morning animals were least active.

Boar odour - flavour discrimination of androstenone and skatole in a triangle test

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Surgical castration is routinely practiced in male pigs destined for fattening. The aim is to prevent, an unpleasant off-flavour which develops in meat of sexually mature entire males. The two main compounds held responsible for boar taint are androstenone and skatole.

Surgical castration however, is associated with pain, especially when performed without anesthesia. An alternative method is the vaccination against boar taint, using Improvac® (Pfizer Animal Health, Louvain-la-Neuve, Belgium). Improvac® is composed of a synthetic GnRH-analogon conjugated to a carrier protein. Schmoll et al. (2009) demonstrated that vaccination of boars against GnRH reliably controls boar taint. Nevertheless, off-flavours may still occur especially in cryptorchid and hermaphrodite pigs as well as in sows. Since about 75% of the consumers are sensitive to boar taint it is necessary to deploy specially trained personnel at the slaughterline for a reliable identification of carcasses with malodours. The selection of suitable test persons is a key factor in this context and analytical tests are necessary to distinguish "smellers" from "guessers".
80 healthy probands (63 females, 17 males) underwent a specially designed triangle test which examines a probands ability to smell androstenone and skatole. The analysis of the results showed that only approximately one third of the probands was able to smell both components. Only minor differences could be identified between males and females. This means, that gender possibly plays only a subordinate role in a person's ability to smell boar taint and that other influencing factors have to be elucidated in the future.

Effects of essential oils in pigs - a review

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Plant active ingredients, such as essential oils, are considered an alternative to antimicrobial growth promoters. Previous studies have shown that essential oils affected the intestinal microflora, nutrient digestibility and growth performance of piglets under experimental conditions. Effects of a blend of essential oils derived from oregano, thyme, anise and citrus are summarized in Table 1.

Table 1. Effects of essential oils on post-weaning growth performance of pigs

Trial	n[1]	Duration days	Effects of essential oils on: ADG	Feed intake	FCR[2]	Reference
			(% of Control treatment)			
US	48	42	+6.2	-2.5	-3.5	Sulabo et al. (2007)
Denmark	192	50	+5.2	+1.2	-4.5	Maribo (2000)
Austria	40	21	+5.3	+3.8	-1.9	Kroismayr et al. (2008)
France	24	20	+3.7	+0.1	-3.4	Steiner et al. (2010)
France	24	20	+4.2	-3.4	-7.2	Steiner et al. (2010)
Austria	30	56	+4.9	+0.2	-4.3	Unpublished

[1]n = number of pigs per treatment
[2]FCR = Feed conversion ratio

Furthermore, a field experiment was carried out on a commercial farm in Italy to investigate post-weaning growth performance of piglets fed supplemental EO. In total 2921 pigs, weaned at three weeks of age and with an average initial BW of 7.21 kg, were housed in 52 pens and assigned to two groups with 26 pens per group: (1) pigs fed a commercial diet based on corn, wheat, barley and soybean meal; and (2) pigs fed the basal diet + EO (500 g/t). Pigs fed EO were on average 720 g heavier at the age of 74 days, indicating that supplementation of the diets with EO positively affected growth rates. Thus, average daily gain was 508 g and 522 g and feed conversion ratio was 1.666 and 1.660 in Group 1 and 2, respectively. Mortality was 2.91 and 1.67% in Group 1 and 2, respectively. In conclusion, pigs fed supplemental EO had higher post-weaning growth performance under commercial production conditions, hence confirming results of scientific experiments under experimental conditions.

Cross-sectional study on the occurrence of MRSA as nasal colonizer in conventional German pig herds

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Introduction:

The phenomenon of the subclinical colonization of pigs with MRSA is known in several pig producing countries. In 2008 the EFSA carried out a baseline study on the occurrence of MRSA in sow herds by analysing collective dust samples. The MRSA-prevalences differ remarkably (0% - >40%) in the European countries. This paper describes a cross-sectional study on the occurrence of MRSA in sow and finisher herds in regions with high and low pig density in Germany.

Material and Methods:

The presented cross-sectional study took place in 2009 and 2010 and was divided into two parts: a) occurrence of MRSA in collective dust samples from 32 sow herds with affiliated nursery sites and 56 finishing herds according to the EFSA´s approach in the baseline study, and b) occurrence of MRSA in nasal swabs from 14 sow herds with affiliated nurseries and from 15 finishing herds with a sample size of 60 tested animals per herd to estimate the intra-herd prevalences. All samples were selectively enriched and cultured on MRSA-selective chromagar plates. All cultured isolates were confirmed by PCR.

Results:

The results in Tab. 1 and Tab. 2 show a high proportion of MRSA-positive sow and finishing herds. The proportions of MRSA-positive herds were equal in all tested regions in Germany.

Tab. 1: Proportion of MRSA-positive sow herds in different regions in Germany

Region (pig density)	***Collective dust sample:*** **No. of MRSA-positive sow herds/ No. of tested sow herds**	***Nasal swabs:*** **No. of MRSA-positive sow herds/ No. of tested sow herds**
Lower-Saxony (high pig density)	4/5 (80%)	3/3 (100%)
North Rhine Westfalia (high pig density)	9/11 (82%)	3/4 (75%)
East Germany (medium pig density)	2/3 (67%)	3/3 (100%)
Bavarian (low pig density)	10/13 (77%)	4/4 (100%)
Total	**25/32 (78%)**	**13/14 (93%)**

Tab. 2: Proportion of MRSA-positive finishing herds in different regions in Germany

Region (pig density)	***Collective dust sample:*** **No. of MRSA-positive finishing herds/ No. of tested finishing herds**	***Nasal swabs:*** **No. of MRSA-positive finishing herds/ No. of tested finishing herds**
Lower-Saxony (high pig density)	16/19 (84%)	3/3 (100%)
North Rhine Westfalia (high pig density)	21/25 (84%)	3/4 (75%)
East Germany (medium pig density)	2/4 (50%)	2/4 (50%)
Bavarian (low pig density)	5/8 (63%)	4/4 (100%)
Total	**44/56 (79%)**	**12/15 (80%)**

Discussion:

It could be shown, that the MRSA is wide-spread in German sow and finishing herds and that the occurrence of MRSA in pig herds is not resp. not only depending on the pig density.

Dietary valine and tryptophan for piglets: feed intake affects the ideal protein concept

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Feed formulation is partially based on the ideal protein concept, based on which the AA requirements are expressed relative to lysine. This theory states that increasing the supply of one amino acid will improve performance only if no other amino acid is limiting. The present experiment aimed to investigate the interaction between valine and tryptophan concentration on growth performance of piglets. In four batches, 96 pigs were divided over 16 pens, with a total of 386 pigs. Each pen was randomly assigned to one out of four treatments: low valine, low tryptophan (LL); low valine, high tryptophan (LH); high valine, low tryptophan (HL); and high valine, high tryptophan (HH). The pigs received a standard feed (11.5g lys/kg, 9.8MJ net energy) during the first week after weaning (4 weeks), then received the experimental feeds between 5 and 9 weeks of age. The animal performance variables were subject to the univariate ANOVA procedure, with valine and tryptophan concentration as fixed factor. Valine concentration had a large effect on feed intake and daily gain (Table 1).
Interestingly, both tryptophan and valine concentration affected the feed conversion ratio, without an interaction between them. This contradicts the ideal protein concept. The effect on feed intake probably influenced the feed conversion ratio irrespective of the need for protein deposition. We conclude that in order to obtain a sufficiently high feed intake, an adequate valine content is important in the newly weaned piglets' feed.

Table 1. Effect of dietary valine and tryptophan concentration on performance results of piglets between 5 and 9 weeks of age

		LL	LH	HL	HH				
SID valine		0.6	0.6	0.7	0.7	SEM		P	
SID tryptophan		0.18	0.22	0.18	0.22		VAL	TRP	VALxTRP
Daily feed intake (g/day)	Means	731	735	826	822	11	<0.001	0.871	0.952
Daily weight gain (g/day)	Means	408	428	504	505	7	<0.001	0.136	0.215
Feed conversion ratio (g/g)	Means	1.79	1.72	1.64	1.63	0.01	<0.001	0.040	0.187

Occurrence and antimicrobial susceptibility of Campylobacter spp. recovered from liver surfaces of slaughtered pigs

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Aim of the study

The purpose of the study was to evaluate the prevalence and the resistance pattern of Campylobacter spp. isolated from liver surfaces of slaughtered pigs.

Materials and Methods

1,500 liver surfaces of pigs from 50 herds were swabbed during slaughtering process. Thermophilic Campylobacter (C.) spp. were isolated by enrichment in Bolton-Broth and cultured on mCCDA microaerobically. The identity of the isolates was verified by PCR. Susceptible testing of 24 C. coli isolates from liver surfaces was performed by a broth microdilution method. NCCLS breakpoints for the family Enterobacteriaceae (for erythromycin, the MIC interpretive standard of Staphylococcus) were used.

Results

Out of 1,500 swabs from liver surfaces, 147 (9.8 %) were positive for Campylobacter spp., with C. coli as the predominant species (78.9 %). The highest resistant rate of C. coli isolates was recognized for trimethoprim/sulphamethoxazole and ciprofloxacin (Tab. 1).

Table 1: In vitro resistance of C. coli strains of porcine origin

Antimicrobial Agent	Breakpoint (mg/L)	Portion of resistant strains (n=24)
Erythromycin	≥ 8	20.8 %
Gentamicin	≥ 16	0 %
Ampicillin	≥ 32	4.2 %
Ampicillin/Sulbactam	≥ 32/16	0 %
Nalidixic acid	≥ 32	8.3 %
Ciprofloxacin	≥ 4	33.3 %
Tetracyclin	> 16	29.2 %
Trimethopim-Sulphamethoxazole	≥ 4/76	41.7 %

Discussion and Conclusion

In human medicine campylobacteriosis should normally only require antibiotic therapy if there is invasive or persistent disease. Macrolide and fluoroquinolones are the drugs of choice (2). Trimethoprim/sulfamethoxazole, ciprofloxacin, tetracycline and erythromycin are the antimicrobial agents, which showed high resistant rates in C. coli strains isolated from pig livers. Although porcine C. coli strains were not considered to play a major role in human campylobacteriosis (1), the development of the resistance should be monitored, especially because of the risk of resistance transfer. Additionally, the findings reinforce the importance of good hygiene in the home and adequate cooking of meat to avoid cross-contamination.

Acknowledgements:
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A vitality scoring method based on piglets behaviour

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The objective was to develop a vitality scoring method, easy to obtain, related with piglet performance during lactation. From 21 multiparous sows, 266 piglets were used. After farrowing (day 0), piglets were weighted and individually tested for 3 parameters (table 1) in a circular enclosure (55cm diameter) receiving a total MUN's score (0-6) and weighted again on day 1 and day 20 (weaning). Sows farrowing information was also registered. Regression analysis was performed using GLM procedure of SAS. Piglets weaning BW was influenced by birth BW (P<0.0001), MUN's score (P<0.05) and total born piglets of the lactating sow (P<0.0001); with an overall model P-value <0.0001. MUN's vitality score, in combination with birth BW and sow information might be useful to predict piglet's performance capacity throughout lactation helping to improve their management.

Table 1:

Movement capacity (M)
0: Unable to keep a voluntary position
1: Voluntary position but NO movement (unable to turn more than 90º)
2: Moving “slowly” (turn more than 90º within 30s.)
3: Moving “fast” (turn more than 90º within 15s.)
Udder searching (U)
0: NO searching or udder stimulation behavior within 30s.
1: Searching or udder stimulation behavior within 30s.
Number of rounds (N)
0: No able to turn 360º nor walk along the limits of the enclosure
1: Able to turn 360º or walk along the limits of the enclosure within 30s.
2: Able to turn 360º or walk along the limits of the enclosure at least twice within 30s.

C Reactive protein differentiates lymphoid depletion severity in wasted pigs

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Introduction

Serum concentration of C-reactive protein (CRP) increases during the acute phase response and it is a useful marker of clinical disease in pigs (Pallarés et al., 2008). The aim of this study was to assess the relation between the CRP concentration in serum and the degree of lymphoid depletion in wasted pigs clinically diagnosed as Post Weaning Multisystemic Wasting Syndrome (PMWS).

Material and methods

Mediastinic, traqueobronquial, inguinal and mesenteric lymph nodes, tonsil and spleen from 50 wasted pigs were fixed in formalin, embedded in paraffin and stained with haematoxylin and eosin for histopathological examination. Lymphoid depletion was categorized as no depletion (0), low (1), middle (2) or severe depletion (3). Whole blood was obtained and serum levels of CRP were quantified by commercial ELISA kit. Test of Mann-Whitney's U was performed.

Results

CRP concentrations depending on lymphocyte depletion score are represented in table 1. CRP levels presented statistical differences between pigs with no depletion and pigs with low, middle or severe depletion ($p = 0.011$; $p = 0.023$; $p = 0.005$ respectively).

Table 1: Concentration of CRP ± standard deviation for each lymphocyte depletion score.

Lymphoid depletion	CRP (µg/ml)
0 (n = 16)	55.65 ± 22.06
1 (n =12)	143.88 ± 33.07
2 (n = 9)	140.70 ± 31.75
3 (n = 13)	135.05 ± 23.83

Discussion

CRP levels are elevated in pigs with lymphoid depletion, which could be explained because this protein modulates lymphocyte mediated immune responses proportionally to its concentration producing diminished proliferative responses (Mortensen et al., 1977). Elevated CRP levels may modulate cell-mediated immune responses contributing to the immune impairment of wasted pigs. CRP could be used as a complementary tool to monitor lymphoid depletion in experimental viral infections.

Reduced feed intake in pigs – due to disorders or diets`quality?

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A low feed intake belongs to one of the common problems on pig farms and results in a reduced performance combined with high economic losses. Causes of a reduced feed intake are possibly an illness of the pigs but also aberrations within the feed. Besides variations of the botanical composition (high levels of components with a low taste due to antinutritive factors like rape seed meal, peas a.s.o.) specifics of the chemical composition (e.g. an excess of nutrients like calcium, sodium or copper) can also lead to a low palatability in pigs.

Moreover, a microbial contamination (e.g. a reduced hygienic status due to higher levels of colony forming units of yeasts), mycotoxines (especially vomitoxine) or a physical contamination (e.g. foreign bodies like plastic particles from building of a new fooder silo) have to be mentioned. Furthermore, diets` physical form (indirect by gastric ulcers) and an insufficient dry matter content in liquid feeding systems (dry matter intake capacity of pigs as limiting factor) may lead to a lower amount of ingested feed. Last but not least the water supply and its quality might influence the feed intake. Beside an evaluation of 215 feed samples sent in to the consulting service within the last three years with the nutritional history of a reduced feed intake the diversity of reasons that come into consideration in this situation will be spotlighted by several case reports in which a reduced feed intake was observed and reported by the owner or veterinarian.

Pro-inflammatory and immune cytokines in pbmc of vaccinated and unvaccinated pigs exposed to porcine circovirus type 2 (pcv2) natural infection

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The modulation of pro-inflammatory (IL-8, TNF-a) and immune (IFN-y, IL-10) cytokines was evaluated in PBMC of pigs vaccinated with a single dose of a PCV2-Cap-based vaccine and in unvaccinated pigs exposed to natural infection. The cytokine response in unvaccinated-infected animals was evaluated with regards to clinical signs of PMWS. The piglets of a conventional herd with positive history of PMWS in animals aged older than 15 weeks were weaned at 21±3 days; at weaning the animals of the vaccinated group were vaccinated with Porcilis PCV®+adjuvant intramuscularly whereas adjuvant only was administered to controls. Blood samples collected before PCV2 viremia (16 weeks) and after infection/clinical signs of PMWS (19 and 22 weeks) were tested. Cytokine gene expression was assessed by real-time PCR in vaccinated (PCV2-vac), unvaccinated infected/PMWS-free (Ctrl) and unvaccinated infected/PMWS-affected (Ctrl-PMWS+) pigs. IL-8 levels were higher in Ctrl-PMWS+ pigs early after infection and lower at the later stage, testifying a stronger early inflammatory status and subsequent less efficient innate responsiveness (Fig.1). TNF-a (Fig.1) and IFN-y (Fig.2) levels, evidence of innate and adaptive responses, were higher in PCV2-vac animals at both time points. In Ctrl-PMWS+ pigs, lower IFN-y was associated with higher IL-10 (Fig.2) which represents a possible condition associated with the onset of clinical PMWS. Vaccinated pigs cope with infection showing stronger IFN-y-related cellular reactivity, no IL-10-related negative regulatory effects and no intense inflammatory status following infection.

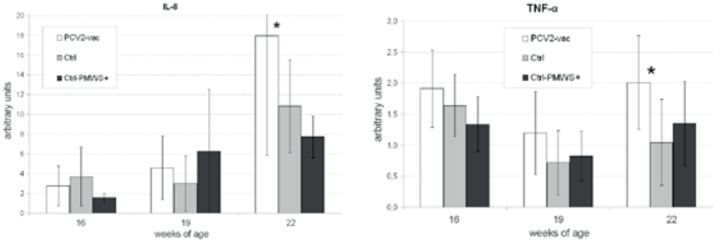

Fig.1: Pro-inflammatory cytokine gene expression in PCV2-vaccinated and unvaccinated naturally infected pigs.

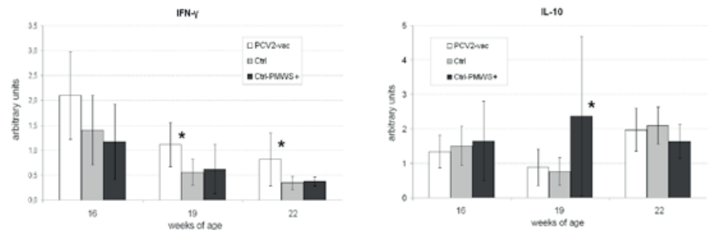

Fig.2: Immune cytokine gene expression in PCV2-vaccinated and unvaccinated naturally infected pigs.

Pain and Pain reduction in husbandry procedures of suckling piglets

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Introduction

The aim of the study was to compare castration pain with pain of the additional husbandry procedures tail docking and ear tagging. Furthermore the impact of presurgical NSAID administration to both methods was investigated. Dimension of pain and stress was evaluated by cortisol measurements (1,2,3).

Materials and Methods

A total of 209 one-day old male suckling piglets, performed on the 3rd and 4th day of life, were randomly assigned to five treatment groups (Tab. 1). According to treatment groups, piglets were treated with either Fe3+ or Fe3+and Meloxicam 30 minutes before processing. Blood samples were taken from all piglets before treatment and 30, 60 minutes, 4 and 24 hours after processing. Based on cortisol measurements, the impact of the various treatments was examined.

Table 1. *Treatment groups, treatment and number of animals per group.*

Group	Treatment	Processing	n
H	Fe^{3+} 200mg/inj i.m.	Handling	43
C	Fe^{3+} 200mg/inj i.m.	Castration	43
CET	Fe^{3+} 200mg/inj i.m.	Castration, Ear tag, Tail docking	38
CET+M	Fe^{3+} 200mg/inj + Meloxicam 0.4mg/kg i.m.	Castration, Ear tag, Tail docking	41
C+M	Fe^{3+} 200mg/inj + Meloxicam 0.4mg/kg i.m.	Castration	44

Results and Discussion

Mean cortisol values of C and CET increased significantly compared to H up to 60 minutes and up to 4 hours respectively. From 30 minutes up to 4 hours C and CET differed (Fig. 1). This infers that serum cortisol concentration rise due to multiple pain and distress like castration, ear tagging and tail docking. After Meloxicam treatment, CET+M decreased up to 4 hours and C+M at 30 minutes compared to CET and C, respectively. Therefore the application of NSAID before multiple zoo technical surgeries reduced pain equally to NSAID application before castration.

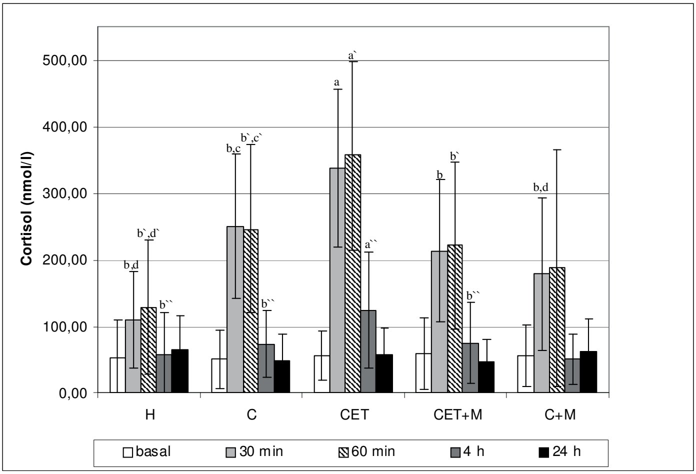

Figure 1. *Average cortisol concentration ± SD (nmol/l) and P before, 30 min, 60 min and 24 h after treatment of the treatment groups (ab; cd; a`b`; c`d`; a``b``: P ≤ 0.05).*

Since these procedures are painful too (4,5), prior NSAID application should be conducted in the same way than it is discussed prior castration. It should be taken into consideration to perform all procedures together after presurgical NSAID treatment.

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Co-infections pcv2 associated in post-weaning pigs in italian herds

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Porcine Circovirus type 2 infection is essential to the development of postweaning multisystemic wasting syndrome, but other co-factors are required to induce clinical signs and lesions. In this study were considered pigs whit post-weaning problems classified as PMWS and NoPMWS-PCV2positive and co-pathogens associated.

The 2 categories were identified through a routine diagnostic protocol that involved necropsy, histologic and immunoistochemistry(IHC) investigations carried out on samples of lung, ileum, tonsils and lymph nodes. Pigs showing typical histological lesions (lymphoid depletion, multinucleated or epithelioid giant cells, macrophage infiltration, amphophilic cytoplasmatic viral inclusions, interstitial pneumonia, granulomatous enteritis) and IHC positive were diagnosed as PMWS while pigs IHC positive whitout typical histological lesions were diagnosed as NoPMWS-PCV-2positive. Moreover bacteriological isolations, PRRSV and SIV PCR investigation were performed on all swine.

396 pigs from 217 farms were examined for problems in post weaning. 205 were PCV2 positive, 164 were PMWS and 41 were NoPMWS-PCV2positive. In both categories the lesions mainly involved the respiratory system. PRRSV was detected in 116 (70,7%) PMWS and in 32 (78%) NoPMWS-PCV2positive, while SIV was detected in 15 (9,1%) PMWS and in 7 (17,1%) NoPMWS-PCV2positive. Were detected by bacteriological investigations Streptococcus sp., Salmonella sp., P.multocida, Ac.pleuropneumoniae, H.parasuis, Ac.pyogenes and Pseudomonas sp. The most frequent pathogen was Streptococcus sp. in PMWS (9,8%) and NoPMWS-PCV2positive (14,6%), followed by Salmonella sp. 9,8% in both categories and P.multocida in 2,4% and 7,3% respectively.

Co-pathogens can be considered to interact with PCV2 leading up to clinical disease and they can be isolated and influence the evolution of PCV2 infection in PMWS and No PMWS-PCV2positive pigs.

High biosecurity measures help to keep african swine fever outside the finnish pig population

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African swine fever (ASF) is one of the most threatening diseases for pig husbandry worldwide. ASF has been recently detected near the northern EU border in Leningrad region (St Petersburg) in 2009 and also in January 2011 representing a current threat for the member countries. Thus a risk profile for ASF entering Finland was conducted.

The risk profile identified many different routes of getting ASF into Finland. Some of them are: infected wild boar entering the country; hunting wild boar in affected areas; people bringing foodstuffs of animal origin from countries where ASF is present; and catering waste from means of transport operating internationally. However, many additional incidents must take place before the infection enters the commercial pig production.

To maintain the ASF free status in Finland, the farmers contribute by keeping up a good biosecurity standard. Strict biosecurity measures at the farm level enable to minimize the risk of contacts with infected pigs, meat products and fomites. Finnish farmers voluntarily follow the guidelines concerning a 48 hrs waiting period before going to the piggery after travelling abroad. Swill feeding of pigs is prohibited, but animal products contaminated with ASF illegally brought into Finland by travellers could be a matter of concern. Contacts with the wild boar population are very unlikely, because it has been approximated that only 6% of the Finnish pigs have the possibility to be outdoors. When new diseases are threatening, maintaining strict biosecurity measures is even more essential.

Outbreak of acute septicaemia by Pasteurella multocida type B in pigs reared in extensive system in Spain

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Acute septicaemic pasteurellosis is generally considered to be an uncommon disease in pigs, although sporadic outbreaks have been reported in India and Sri Lanka (Gamalle et al. 1995). In all cases, clinical symptoms and pathology were characteristic of those consistently observed in haemorrhagic septicaemia (HS) of cattle and buffalo.

For the first time in Spain, a strain of P. multocida serotype B was isolated from a haemorrhagic septicaemia outbreak in seven herds of pigs reared in extensive system in Southwest Spain. The outbreaks showed a mortality and were recorded during December 2009. The disease presented an acute onset, with sudden death in 1-2 days in many animals without apparent clinical signs. Only adult pigs (between 4 and 8 months) were affected.

Post mortem examination revealed haemorrhages, congestion of the lungs and a marked submandibular oedema. Microscopically multifocal areas of necrosis together with infiltrate of neutrophils and fibrin thrombus were observed in the adipose tissue.Tissue samples were collected aseptically for bacteriological and histopathological examination. Impression smears from various organs were also analyzed by direct microscopy.

P. multocida was isolated from various tissues and 33 isolates were identified by biochemical (API 20NE) and molecular (PCR) methods, confirming that they belonged to the species P. multocida. We detected a unique biochemical pattern common to all isolates. Capsular type determination by PCR (Townsend et al, 1998) allowed the detection of P. Multocida serotype B, wich may be circulating in our country.

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Estimation of live weight Landrace x Large White sows through morphometric mensuraments as a strategy to control the amount of feed offered to sows

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In current production systems it is essential to control the amount of feed offered to sows in order to optimize fat reserves avoiding potential productive and reproductive problems. Many farms use body condition score (BCS) and/or backfat thickness (BFP2) as a reference to adjust the amount of feed offered. Body weight (BW) would be a better criterion to decide the amount of feed offered to sows, but weighting sows is difficult and may compromise animal welfare. Thus, having a reliable tool to estimate weight would be an improvement in sow management. The objective of this study was to predict BW using BCS, BFP2, and morphometric measures (HG: heart girth and FF: flank to flank) from Landrace x Large White sows at different farrowing number (0-10) and at three different physiological moments. A total of 530 measurements were performed on 168 sows at weaning, and at 36d and 110d of gestation (moments 1, 2, and 3, respectively). Sows were weighed in each moment and BCS, BFP2, HG and FF measured. Measurements HG and FF together showed a better correlation with BW than BFP2 and BCS, showing the highest values of adjusted R2 (0.81) and lower residual value (15.007). There was a progressive improvement of prediction value when variables ¨farrowing number¨ and ¨moment¨ were added to the model (BW = – 144.04 – 28.82*Part0 – 18.16*Part1 – 6.43*Part2 – 6.41*Part3 + 20.62*Moment3 + 116.99*FF + 183.55*HG). HG and FF could be a better predictor of BW than BCS or BFP2 in Landrace x Large White sows.

Heritability of the Postpartum Dysgalactia Syndrome in sows

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The Postpartum Dysgalactia Syndrome (**PDS**) represents one of the most important diseases after parturition in sows. A genetic predisposition for susceptibility to PDS has been discussed in literature and average heritability of 0.10 was estimated, but current studies are lacking. Therefore, a dataset of 1,680 sampled sows and their 2,001 clinically examined litters was used for variance components estimation with a threshold liability model. Sows were defined as PDS-affected through clinical examination 12 to 48 hours after parturition with emphasis on rectal temperature, mammary glands, and behaviour changes of sows and piglets as well. All animals were housed on farms with similar management conditions, animal health and hygiene standards to provide maximal comparable environmental factors. The posterior distributions of the individual variance and the permanent environmental variance for the susceptibility to PDS were determined with a single trait repeatability model. Posterior mean of additive genetic variance was 0.10, and estimated heritability for PDS averaged 0.09 with a standard deviation of 0.03. The results are in agreement with those of other studies and emphasize the importance of optimizing hygiene and management conditions as well as considering the genetic predisposition.

Evolution of back fat thickness of sows and piglet performance throughout lactation in relation to initial body condition and feeding strategy of sows during the peripartal period

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The present trial investigated the influence of peripartal feeding strategy (ad libitum versus restricted) and sows' condition on sow and piglet performance. Based on back fat thickness at the P2 (day 106 of gestation), sows were divided into three condition categories (skinny (n=26, back fat<16mm), normal (n=57, back fat 16 to 22mm), fat (n=30, back fat>22mm)). Sows were fed ad libitum or restricted (decreasing towards farrowing, increasing afterwards) from day 106 of gestation until day 7 of lactation. Afterwards all sows were fed ad libitum until weaning (day 28 of lactation). Back fat thickness was determined every other day during the peripartal period and then weekly until weaning. Birth litter weight was determined, littersize was standardised and litters were weighed at weaning. Ad libitum fed sows' back fat increased until farrowing and decreased towards weaning.This resulted in lower back fat losses between day 106 of gestation and weaning for ad libitum fed sows (2.2±2.8mm, P=0.092) when compared to restricted fed sows (3.2±3.0mm). With regard to condition, skinny sows lost significantly (P<0.001) less back fat (0.9±3.0mm) than normal (2.6±2.5mm) sows which on their turn mobilised less than fat sows (4.5±2.8mm). Birth litter weight was not affected by any test-factor. Piglets of ad libitum skinny sows were significantly heavier (9.0±0.8kg, P=0.006) at weaning. Piglets of ad libitum fat (7.7±1.3kg) and restricted normal sows (7.7±1.1kg) were significantly lighter. In conclusion, skinny sows fed ad libitum performed better implicating that peripartal feeding strategy and condition are important factors determining sow and preweaning piglet performance.

Duration of maternally derived antibodies in Toxoplasma gondii naturally infected piglets

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Toxoplasmosis is a worldwide zoonotic disease caused by Toxoplasma gondii, which infects humans and most warm-blooded animals. Pigs are considered an important source of infection for humans and T. gondii can cause mortality in neonatal pigs. A longitudinal study was performed to analyze the dynamics of T. gondii antibodies in naturally infected piglets from 1 to 25 weeks of age. Seventy three piglets from 20 seronegative sows (modified agglutination test, MAT $<1:25$) and 20 naturally infected T. gondii seropositive sows (MAT $\geq 1:25$) were analyzed at 1, 3, 6, 9, 12, 15, 18, 22 and 25 weeks of age. Twenty-six of the 73 piglets analyzed (35.6%; CI95%: 25.5-45.7) were seropositive at some point during the study. Seroprevalence in piglets at one and three weeks of age was significantly higher in animals born from seropositive sows as an indication of maternally derived antibodies. The longest persistence (up to six weeks of age) was observed in two piglets whose dam had high T. gondii antibody level (MAT $\geq 1:500$), while persistence of maternally derived antibodies in the piglets born from sows with low antibody titers (maximum 1:50) was shorter and lasted only up to 3 weeks of age, when the piglets were weaned. The risk of horizontal transmission in piglets increased with age and was higher in piglets during the finishing period. The present results indicate that the decline of T. gondii maternally derived antibodies in naturally infected piglets is associated with the titers of their dams.

Oestrus induction with peforelin, new insights

Jan Jourquin[1], Lieve Goossens[1], Janssen Animal Health

Peforelin is a GnRH that specifically induces the release of FSH in pigs. It is registered for induction of oestrus (Maprelin®). In a multi-center blinded placebo field trial, the effect of peforelin treatment on reproductive and litter performance was evaluated.

Eleven farms were included (4333 sows), randomly spread over parities and treatments. Treatments (peforelin (M) and placebo (P)) were performed according the registered indication. Wean to oestrus interval (WOI), farrowing success rate (FSR = litters per 100 treatments) and litter size (total born) were recorded. On nine farms, individual piglet growth and mortality of a full farrowing batch was recorded (361 litters). For statistical analysis, comparisons controlling for farm were performed. WOI tended to be shorter (M 5.26 days, P 5.41 days) and FSR was better (M 81.9%, P 79.4%) for M ($p<0.05$). Litter size was similar (M 13.67, P 13.67). Two response profiles could be distinguished: 1. Farms with only a positive effect on FSR in primiparous sows (M 88.2%, P 74.7%) ($p<0.001$). 2. Farms with only a positive effect on FSR in gilts and multiparous sows (M 81.9%, P 77.0%) ($p<0.01$). The combined effect of peforelin on piglet mortality and body weight gain resulted in an increased litter weight gain (M 56.6 kg, P 53.3 kg) ($p<0.05$), independent of the response profile and parity.

Optimum dosing in relation to the body condition at weaning is the most likely cause for the differences in FSR between farms. Stimulation of follicle development with perforelin positively impacts the litter performance.

Cross-neutralization and hemagglutination-inhibition between a porcine parvovirus inactivated vaccine and a new heterologous genotype.

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HIPRA (Spain)

Introduction
Recently, a new genotype of the porcine parvovirus (PPV) showing highly pathogenicity in pregnant gilts (high mortality of foetuses) has been described and characterized.1, 2 In this study, the virus neutralization (VN) and hemagglutination inhibition (HI) activities with post-vaccination sera (genotype 1) was investigated to infer in vitro, the protective effects of vaccines against PPV field isolates that differ from the reference and vaccine strains (genotype 2).1

Materials and methods
Six clinically healthy PPV-naïve finisher gilts, were vaccinated twice, 3 weeks apart, with a 2-ml intramuscular dose of PARVOSUIN® MR (inactivated vaccine containing PPV and Erysipelothrix rhusiopathiae in oil adjuvant) (Hipra, Amer, Spain). Serial dilutions of heat-inactivated post-vaccination sera were used for antibody titration by the HI and VN assays, as previously described. Tests antigens consisted of homologous NADL-2 (PARVOSUIN® MR vaccine seed stock) and heterologous PPV-27a strains (prototype genotype 2).

Results
Five out of 6 post-vaccination sera tested positive for both antigens in the HI assay, although titres were rather low, ranging from 20 to 160. Similar results were obtained in the VN test, with the same 2 individuals showing low or non-detectable levels of antibodies. (Table 1).

Table 1. Homologous and heterologous HI and VN assays with 6 post-vaccination sera from adult pigs vaccinated twice with a PPV-SE inactivated vaccine.

Serum	Homologous HI (NADL- 2*)	Heterologous HI (27 a**)	Homologous VN (NADL- 2)	Heterologous VN (27 a)
1	1:160	1:80	1:160	1:160
2	1:160	1:160	1:320	1:160
3	1:160	1:80	1:80	1:160
4	1:40	1:20	1:20	1:20
5	1:160	1:80	1:320	1:160
6	<1:10	<1:10	<1:10	<1:10

HI positive titres ≥1:80; * PARVOSUIN® MR vaccine seed stock; ** PPV genotype 2 prototype

Discussion
Previous challenge experiments with pregnant sows have shown that low HI and VN antibody titres at the day of infection, conferred clinical protection to the foetuses avoiding mummification.1 Although antibody levels observed in most of the sera analyzed in this study were low, it is reasonable to predict that successive vaccinations in the farm environment will be sufficient to confer protection, even when the challenge virus is variant.

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Improvement of reproductive parameters after sow vaccination with CIRCOVAC® (Merial) in a Bulgarian Farm

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Introduction

The purpose of this study was to evaluate the effect of CIRCOVAC sow vaccination on reproduction performance.

Materials and Methods

The study was conducted in a 2,700-sow farrow-to finish, DanBred registered herd with every 4 days farrowing batches and strict all in/ all out pig flows.

Vaccination:

• Before the observation period: Piglets used to be vaccinated with CIRCOVAC at 28-30 days of age, 0.5ml, IM, once.
• In August 2009: a mass sow CIRCOVAC-vaccination was carried out twice, 3 weeks apart, followed by routine booster 2 weeks prior farrowing.

Results

There was a major increase in total and live born per litter (1.7 and 1.6) meaning for an average of 2.5 reproductive cycle in the farm: 4.25 and 4 total and live born piglets/ sow/ year.

In this study, mortality in farrowing pens was artificially increased by the elimination of underweight offspring (<840g), subsequent to the improvement of the total and live-born piglets.

Table 1: Reproductive parameters (averages)

	Before	After	Δ	p (K.W)
Number of service	130.6	136.7	6.1	0.276
Returns %	6.0	5.7	-0.3	0.463
Conception rates	87.6	90.3	2.7	***0.081***
Farrowing	120.8	118.4	-2.3	0.463
Total born/lit	13.4	15.1	**1.7**	**0.000**
Live born/lit	12.0	13.5	**1.5**	**0.000**
Stillborn/lit	1.4	1.6	0.2	0.168
Total weanings	117.5	118.8	1.3	0.856
Suckling days	28.7	29.2	0.4	0.116
Weaned per litter	11.3	11.4	0.1	0.124
Kg/pig weaned	7.4	7.6	**0.2**	**0.048**
Mortality % in Farrowing pens	12.6	16.6	**4.0**	**0.000**

(KW = Kruskal-Wallis) Results were considered as significantly different when p<0.05.

Discussion & Conclusion

The final results corroborated, except for one parameter, the results described in many countries that consistently showed improvement in reproduction parameters after sow vaccination with CIRCOVAC.

Actinobaculum suis tube agglutination test as a diagnostic tool in urinary tract infection of sows

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Introduction

Actinobaculum suis (A. suis) is a particularly significant causative agents of urinary tract infection (UTI) in sows. The diagnosis of UTI by bacteriological cultivation and urine spot tests are frequently unreliable1,2. Serological examination by indirect immunofluorescence test (IIFT) with A. suis titre 1:16++ could detect the actually infected animals (sensitivity 100 %)3. Based on some preliminary studies4, we elaborated a tube agglutination test to detect antibodies against A. suis. A. suis tube agglutination test (As-TAT) proved to be useful diagnostic tool under farm condition5.

Material and methods

Agglutinin titre against A. suis was determined using a tube agglutination test as follows: Phase I.: A. suis ATCC 33144 was cultivated on blood agar under anaerobic conditions for 2 days. Growth was harvested in PBS (pH 7.2) and adjusted by photometry to contain about 5 x 109 CFU/ml of A. suis.

Phase II.: Sow sera for testing were inactivated at 56 °C for 30 min. Serial two-fold dilutions of the sera were prepared in PBS (pH 7.2). An equal amount of standardized antigen was added to each dilution. The mixture were incubated at 37 °C for 2 h and subsequently kept at room temperature overnight. The degree of agglutination was expressed as: --, no agglutinated sediment; +++, complete sedimentation, clear supernate. Degree of +++ were regarded as positive. Negative control tube: the same amount of antigen suspension given to the serial two-fold dilution of PBS pH 7.2 being free from sera. Positive control tube: serial two-fold dilutions of the sera of known high titer (> 1:1024) prepared in PBS (pH 7.2).

Results and discussion

As-TAT is a cheap, reproducible diagnostic tool to detect the A. suis infection. IIFT with 1:16 is equivalent to 1:32 titre in As-TAT.

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Effect of urinary acidifier on reproduction performance in sows

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Urinary tract infections (UTI) are among the most common health problems in sow herds. From 17 to 40% of sows suffer from UTI, which consequentially leads to increased non-productive days, early cullings and decreased litters/sows/year. The 48 sows were assigned to two different diets. The control group received commercial gestation and lactation diets, whereas the trial group received the same diets supplemented with 0.5 % of a blend of phosphoric acid (PA), anionic substances (AS) and plant extract (PE) (Biomin® pHD, BIOMIN, Austria). The farrowing duration, number of born alive and stillborn, body weights at birth and weaning were determined. The urinary pH was measured at the beginning of the trial, d 108 and d 112 of pregnancy, at farrowing, d 14 and d 21 post-farrowing and a day after weaning and a day after insemination. The results of the present study showed that supplementation of the blend of PA-AS-PE decreased the urinary pH ranging from 0.08 to 0.41 pH units. The duration of the farrowing time between the first and the last piglet was shortened by 19% in the trial group. Moreover, the reproduction performance of sows in the trial group was improved by higher number of born alive and lower number of stillborns. Moreover, in the trial group litter size and litter weight at weaning were increased by 24 and 20%, respectively, compared to the control group. The dietary supplementation with the blend of PA-AS-PE in the diets improved the farrowing and reproduction performance of sows.

Immunoglobulin G in sow colostrum

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Introduction

Immunoglobulin concentrations of sow colostrum decreases rapidly after farrowing (1). This is claimed to have negative impact of the last borns of the litter. The aim of this study as to measure the levels of Immunoglobulin G (IgG), total protein (TP) and gammaglobulin (y-glob) at the beginning and midway of farrowing, and the effect of parity number and litter size upon these.

Materials and methods

Colostrum at the start of farrowing and after 6-8 piglets (midway) was in 59 Landrace-Yorkshire sows analyzed for IgG on Single Radial Immunodiffusion Plates (VMRD, Washington) and for TP and y-glob, by serum electrophoresis (Central Laboratory, Norwegian School of Veterinary Science). Parity number and litter size were registered. Statistical variance analyses was performed in JMP8.

Results

IgG levels at the beginning of farrowing, but not midway, was significantly associated with parity number ($p<0.05$), Figure 1. There was no significant association between TP or y-glob and parity number at any time, nor between any of the proteins and litter size. There was significant difference in TP and y-glob between registrations, but not in IgG levels, Table 1.

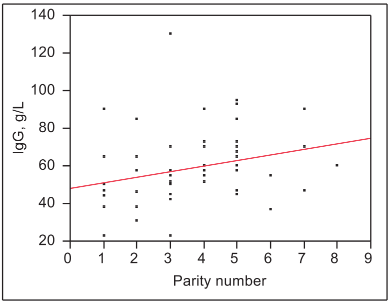

Figure 1. Colostral Immunoglobulin G (IgG) levels at the beginning of farrowing, related to parity number

Table 1. Means of Immunoglobulin G (IgG), total protein (TP) and gammaglobulin (y-glob) in colostrum at the beginning and midway of farrowing.

Time of farrowing	IgG, g/L (SE)	TP*, g/L (SE)	y-glob*, g/L (SE)
Start	59 (2.5)	162 (2.9)	67 (2.2)
Midway	58 (2.8)	157 (2.8)	64 (2.1)

*P<0.01 for difference in concentration of TP and y-glob between registrations.

Discussion and conclusion

The IgG levels in this study is within the range of other studies (2), and did not fall significantly from start- to midway of farrowing. Older sows had increasing colostral IgG levels. The results of this study do not support that decreasing IgG levels is of major concern for the later born piglets of a litter.

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Effects of GnRH down-regulation using deslorelin (Suprelorin®) on sexual function in boars with unilateral abdominal crypthorchidism

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Down-regulation with the Suprelorin® (contains 4.7 mg of the GnRH analogue deslorelin) has been shown to suppress sexual functions in intact boars up until market weight. This study was conducted to test the effect of Suprelorin® on testis function in boars with unilateral abdominal crypthorchidism (n = 6) versus intact boars (n = 4). Insertion of the implant occurred at the age of 12 weeks. Animals were observed until castration at 24 weeks and the testicles morphologically examined. Blood was collected for analyses of testosterone. Testicles of the crypthorchid boars were all markedly smaller compared to intact boars. Moreover, in two boars with unilateral crypthorchidism, the intraabdominal testicle could not be detected at surgery. Most noticeable, the concentrations of testosterone were close to zero in Suprelorin® treated boars and thus much lower than in intact boars. Results indicate that suppression of sexual functions due to GnRH down-regulation using deslorelin through an implant such as Suprelorin® is possible in boars with unilateral abdominal crypthorchidism, and thus may be used as an alternative for surgical testis removal.

Genetic variation of the Postpartum Dysgalactia Syndrome in sows

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Postpartum Dysgalactia Syndrome (PDS) in sows is an important disease after parturition, affecting sows' and piglets' health and welfare. Genetic predisposition for PDS has been discussed, but has never been investigated in detail. Therefore, genetic variation was evaluated in a genome-wide association (GWA) approach with a family-based case-control study. Five German farms were selected for data recording. All selected farms had similar husbandry and feeding management as well as hygiene standards to provide best possible assimilable environmental factors. Sows were identified as affected when they showed rectal temperatures above 39.5°C and/or clinical signs like reddening, swelling or hardening of mammary glands and/or affected piglets. Paternal half- or fullsib sows were chosen on the farm as a matched sample. In these control sows, rectal temperature was measured and their mammary glands and piglets were clinically assessed, too. The PorcineSNP60 BeadChip from Illumina was used for genotyping on 62,163 Single Nucleotide Polymorphisms (SNPs). After quality control, 585 sows (314 affected versus 271 unaffected control sows) and 49,740 SNPs remained for GWA analysis. Statistical analysis included principal components analysis to correct for genomic kinship in an adjusted score test. Statistics were done in use of the package GenABEL within the R statistical environment. Putative chromosomal regions were identified to be associated with PDS. Positional candidate genes in these regions as well as functional candidate genes were evaluated.

A safe and efficacious MLV vaccine contributes to control and eradication of PRRSV

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Introduction

PRRSV infections still have a major impact on pig production, even though vaccines have been in use for more than 15 years. Inactivated vaccines have a limited efficacy (Scortti 2007, Zuckermann) but, in contrast, Modified Live Virus (MLV) vaccines have been shown to be effective in the main. In the US, stabilization and subsequent eradication have been achieved largely by herd closure and partial depopulation (Corzo), the basic concept being to prevent the presence of susceptible animals. All incoming gilts are exposed to PRRS field or vaccinal virus.
A major concern with respect to MLV vaccines was, and still is, a particular aspect of their safety: the vaccinal virus of all MLV PRRS vaccines spreads, at least to some extent (Scortti 2006).The risk with these vaccines, especially the potential to revert to virulence (which actually occurred with a US strain MLV vaccine [Botner]), has long been the subject of discussion. This paper aims to show that not all MLV vaccines are similar in this respect.

Materials and Methods

In Denmark, a trial was carried out to measure the spread of vaccinal virus between sows. Nine pens of weaners (78 in total) were vaccinated with Porcilis® PRRS, a MLV vaccine based on an EU strain. Two other pens of weaners located between these pens, were left unvaccinated to provide sentinel piglets. Also, 15 sentinel unvaccinated sows were housed in the same building but without direct (nose to nose) contact with the piglets. Blood samples were taken from the sows six times at 3-weekly intervals (Astrup).
Five further trials were undertaken to determine the transmission of Porcilis PRRS, in two of which the spread was compared to that of another PRRS MLV vaccine based on the US strain. Some piglets were vaccinated and some left as sentinels, and blood samples were taken regularly from all of them up to 9 weeks after vaccination. The samples were checked for PRRS antibodies, And the transmission ratio (R0) was calculated from the number of seropositives.(R0 is the number of animals that will be infected by a single infected animal).

Results

The Danish trial showed that all vaccinated piglets showed serovonversion in a PRRS ELISA. Only four sows seroconverted and a single piglet of the sentinel groups. Virus was isolated from 23 samples of vaccinated pigs and one sentinel sow taken 3 weeks post-vaccination (and in only one piglet 6 weeks after vaccination.) Based on these data, R0 was calculated to be 0.06 ±0.09(Astrup).
The results from the five comparative trials are shown in Figure 1.

Figure 1 Transmission experiments in weaners

Vaccine	Trial	Piglets		Seroconverted sentinels	R0
		Vacc	Sentinel		
Porcilis PRRS	1	10	4	2	0.20
	2	60	11	2	0.04
	3a	30	6	1	0.03
	4	6	6	1	0.10
	5a	16	24	2	0.10
PRRS US strain	3b	30	6	5	>0.3
	5b	16	24	8	0.40

For trial 5, the chance of R0 > 1 was estimated. For Porcilis® PRRS this was calculated to be 0.001%, and for the PRRS MLV US strain vaccine to be 10%, with the consequent possibility of virus spreading through a pig population (Intervet SPAH data on file).

Discussion

These trials showed that the modified virus of both vaccines does indeed spread to sentinel pigs but to different extents. On a Lithuanian farm, a US strain MLV vaccinal virus circulated for at least 3 years after vaccination (Cepulis 2009). In the field, in Germany where both PRRS-MLV vaccines are used, substantial differences have been found between them (Grosse Beilage). If MLV vaccines are to be used in programs intended to eradicate the PRRS field virus from a farm, or group of farms, it is extremely important that the vaccinal virus does not add substantially to the amount of field virus in circulation. Intensive vaccination of sows in combination with high standards of internal biosecurity and hygiene will reduce the vertical transmission of PRRSV which will assist in producing PRRSV-free progeny (van Groenland). Porcilis PRRS has been shown to be a useful tool in this respect on Italian, French, Austrian and Dutch farms (Martelli 2000,Gambade, Voglmayr, Houben and van Groenland).

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Reduction of mortality and culling by the use of Porcilis® PCV and / or Porcilis® Glaesser

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Introduction

The objective of this study was to assess the efficacy of Porcilis® PCV and / or Porcilis® Glaesser (Intervet Schering Plough AH, Boxmeer, The Netherlands) in reducing mortality and culling. The study was performed at a large pig breeding and fattening farm in Russia with a high number of losses mainly in the nursery. Clinical signs and high mortality rates indicated an involvement of PCV2, in spite of other infectious agents detected on the farm. Additionally, polyserositis was a common finding at necropsy.

Materials and methods

The study was carried out on a Russian farm according to a randomised, controlled and blinded design. A total of 15 638 suckling piglets were divided in 8 groups (table 1). Piglets were assigned to one of four treatments. Group A vac was vaccinated with Porcilis® PCV, group B vac was vaccinated with Porcilis® PCV as well as Porcilis® Glaesser and group C vac was vaccinated with Porcilis® Glaesser. The vaccines were administered as a two-shot vaccination on the 14th and 35th day of live. In the group with combined vaccination (group B vac), drugs were administered at separate sides of the neck. Piglets of the five remaining groups served as non-vaccinated controls (table 1). Letters A-D represented subsequent batches. In batch A-C pigs were splitted in vaccinated and non-vaccinated animals. Pigs from batch D were splitted in two groups to show the degree of variation within non-vaccinated pigs. Mortality rates and number of cullings were documented until slaughter.

Table 1: Number of animals (n) and vaccination of the study groups

Group	Vaccination	n
A vac	Porcilis® PCV	1 913
A non-vac	no vaccination	1 902
B vac	Porcilis® PCV / Porcilis® Glaesser	1 883
B non-vac	no vaccination	1 965
C vac	Porcilis® Glaesser	1 911
C non-vac	no vaccination	2 069
D non-vac 1	no vaccination	1 892
D non-vac 2	no vaccination	2 103

Results

Figure 1 is showing the total losses segmented in mortality rates and number of cullings. The total losses of batch D were summed up, because results of both groups did not differ significantly. Between non-vaccinated pigs of batch D and pigs of group A vac as well as group B vac a significant difference in total losses of 18.0 % ($p \leq 0.002$) and 16.8 % ($p = 0.002$), respectively, was shown in favour of the vaccinated animals. Furthermore significant differences could be determined between group A vac and group B vac when compared to group C vac ($p = 0.001$). The losses of group C vac and D non-vac were comparable within the range of the common variation of this farm. Within the batches A-C the total losses of the non-vaccinated animals where higher than those of the vaccinated ones showing significant differences in groups with pigs vaccinated against PCV2 (A: 16.4 %, $p \leq 0.001$; B: 13.4 %, $p = 0.020$; C: 0.2 %, $p = 0.290$).

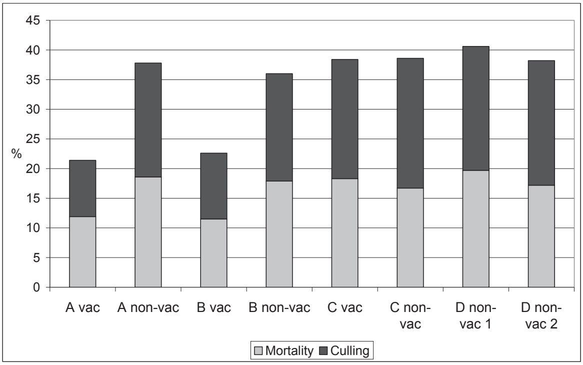

Figure 1: Mortality rates and number of cullings in the different groups

Discussion

Vaccination with Porcilis® PCV and combined vaccination with Porcilis® PCV / Porcilis® Glaesser significantly reduced the total losses during this study.. This indicates that Porcilis Glaesser does not negatively interfere with Porcilis PCV. The fact that vaccination with Porcilis Glaesser had no beneficial effect suggests that during the time of study conduction Haemophilus parasuis infections were not major problems on the farm In conclusion vaccination against PCV2 had a significant influence on the number of animals that died or had to be killed on this farm. This is in line with several other trials where mortality was significantly reduced after vaccination against PCV2 (1, 2, 3). Losses after vaccination were still relatively high. Other infectious causes or management faults have to be considered on farm level.

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Agreement of dam and piglet PCV2 ELISA titres

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A controlled, blinded and randomized study was performed on an Italian 1500-sow farrow-to-weaning farm. The objective of this evaluation was to assess the correlation of sows and offspring ELISA antibody titres. Twenty-four sows selected to be representative for parity and genetic characteristics of breeding were randomly allocated to 2 groups (group A: 12 sows, group B: 12 sows). Sows in group A received 2 ml Circovac® i.m. 6 weeks and 3 weeks before delivery. Subjects in group B were kept as unvaccinated controls. From litters of these sows was randomly selected a sample of about 3 subjects per litter (group C, piglets born to sows vaccinated: 31 animals; group D, piglets born to unvaccinated sow: 34 subjects). Blood samples were collected from sows 10 days after delivery and from piglets at 10 days of age. The sera were tested for antibodies against PCV2 by ELISA (Serelisa®PCV2 Ab, Synbiotics). Animals were assigned into 4 categories based on the median of log10 ELISA titre: low titre sows (<3.74), high titre sows (≥3.73); low titre piglets (<3.91), high titre piglets (≥3.91). The titre distributions of sows and piglets are reported in Fig. 1. Sows and piglets titres by designated low/high categories appear in table 1. Percent agreement of low sows-low piglets and high sows-high piglets titres [(30+26)/65] was 86% with a Kappa of 0.72 (substantial agreement). Vaccination of the sows provides high maternal antibody titres in piglets with a substantial agreement between high sows-high piglets PCV2 titres.

Figure 1. Distribution of sows and piglets PCV2 ELISA titres

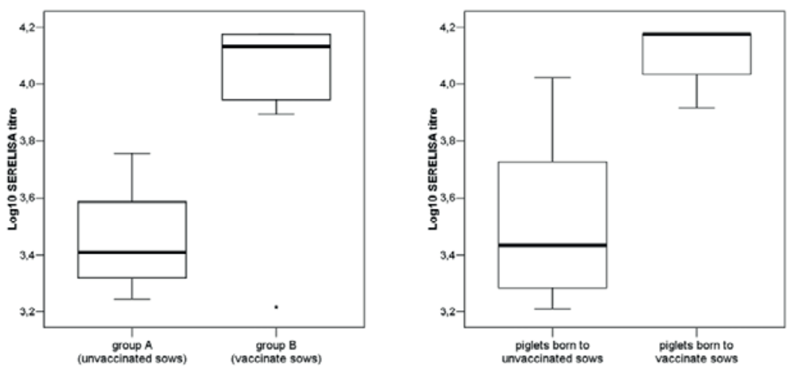

Table 1. Contingency analysis between low and high sows and piglets PCV2 ELISA titres

		Log10 ELISA titre (piglets)		total
		<3.91	≥3.91	
Log10 ELISA titre (sows)	<3.74	30	4	34
	≥3.74	5	26	31
total		35	30	65

A field study in Austria to determine the effects of the simultaneous and concurrent use of Porcilis®PCV and Porcilis®M Hyo on average daily weight gain

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Introduction:

Vaccinations against M. hyo and PCV2 have meanwhile become routine procedures. Recently, the simultaneous use of Porcilis®M Hyo and Porcilis®PCV has been described in a laboratory study (1). This field study shall provide more data about the efficacious and safe simultaneous use of both vaccines.

Materials and Methods:

The study was conducted as a blinded and randomised field trial and 598 piglets from 5 consecutive batches were included and followed until slaughter. For the group allocation and vaccination scheme see table 1.
Animals were weighed at 1, 3, 12 and 25 weeks of age and local reactions after vaccination, mortality and morbidity, as well as lung lesions at slaughter were recorded.

Table 1: vaccination scheme of the study groups

Group	Product:	1st week	3rd week
A	Porcilis PCV		X
B	Porcilis M Hyo	X	X
C	Diluvac Forte (Placebo)	X	X
D	Porcilis PCV		X*
	Porcilis M Hyo	X	X*
E	Porcilis PCV		X**
	Porcilis M Hyo	X	

* Concurrent use: vaccines are given at the same time, but at different sites. ** Simultaneous use: 50ml Porcilis PCV and 50ml Porcilis M. Hyo mixed in a third 100ml vial and is given in one 4ml injection at one site.

Results:

During the fattening period, animals vaccinated with either Porcilis®M hyo or Porcilis®PCV gained more body weight / day than control animals (14 and 19g/day). An even higher ADWG (22-26 g/day) could be observed when animals received both vaccines simultaneously or concurrently (Table 2)
No significant difference between the study groups was observed in terms of mortality, morbidity and lung lesions.
Following vaccination, one animal from group A and C respectively, showed a transient swelling at the injection site. None of the animals developed any adverse events.

Table 2: Average daily weight gain and standard deviation
(Difference compared to control group C)

	Weaning to End (3-25 weeks of age)		Fattening period (10-25 weeks of age)	
	ADWG + STD	Diff.[1]	ADWG + STD	Diff.[1]
A	664.2 ± 76.8	+9.6	844.2 ± 112.1	+14.1
B	663.7 ± 72.1	+9.1	849.1 ± 92.5	+19.0
C	654.6 ± 88.8	-	830.1 ± 132.0	-
D	665.1 ± 81.0	+10.5	856.8 ± 116.9	+26.7
E	665.3 ± 77.5	+10.7	852.4 ± 121.3	+22.3

[1] Difference: Vaccinated group (A, B, D, E) minus Control group (C)

Discussion and Conclusion

The higher ADWG observed following vaccination against M. hyo or PCV2 alone can be further increased, if both vaccines are administered simultaneously or concurrently. Any negative interference between the two vaccines can therefore be ruled out. Together these data suggest that simultaneous or concurrent use of Porcilis®PCV with Porcilis®M Hyo is safe and efficacious. It contributes to animal welfare and reduces time and resources for the farmer.

Acknowlegements

This work was supported by Intervet/Schering-Plough Animal Health.

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Pandemic influenza H1N1 outbreak in Norway 2009/10: A case-control study in swine nucleus and multiplier herds on the protective effects of commonly used biosecurity measures

Carl Andreas Grøntvedt[1], Chiek Er[2], Britt Gjerset[2], Anna Germundsson[2], Tore Framstad[1], Edgar Brun[2], Anne Jørgensen[3], Bjørn Lium[2], Norwegian School of Veterinary Science Norwegian Veterinary Institute Animalia

Introduction

The aim was to study the protective effects of biosecurity measures for infection of H1N1pdm in Norwegian nucleus and multiplier swine herds.

Materials and methods

The study population comprised 118 nucleus and multiplier herds. Three herds were excluded on the basis of uncertain infection status at the time of the study. Of the 115 remaining herds, 47 were nucleus herds, and 68 multiplier herds. All herds were tested serologically or by rRT-PCR during the risk period (30th September 2009 till 31st October 2010). Information on clinical history of humans and pigs were collected by questionnaire and telephone interview.
We calculated the odds ratios (OR) for each risk factor and used one-sided Fisher's exact test to calculate statistical significance.

Results

Response rate from farmers was 100%. A total of 20 (43%) of the nucleus herds and 28 (41%) of the multiplier herds were classified as positive.

Table 1: The strength of the protective effects (OR) and statistical significance

Biosecurity measures, Farmworkers	OR	p-value
Hands washed before entering	0.8	0.42
Hands washed when leaving	0.87	0.55
Disposable gloves (used once)	0.40	0.12
Facemask (unspecified type)	0.79	0.52
48hrs quarantine after travel	0.66	0.45
Biosecurity measures, visitors		
Hands washed before entering	0.88	0.44
Disposable gloves (used once)	0.32	0.06
Facemask	0.48	0.44

Discussion

The results indicate that the protective effects of the biosecurity measures were slight, and the large p-values reflect the fact that these biosecurity measures were implemented in equal proportion in both positive and negative herds. The results may also be indicative of the high infectivity of the H1N1pdm virus in the naïve Norwegian pig population, and the challenges associated with protecting susceptible pigs from infection by this virus. However the use of disposable gloves stands out as having a statistical significant and larger protective effect than the rest of the measures.

Investigation on IDEXX PRRS X3 compared to 2XR-ELISA with sera from PRRS defined german breeding herds

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Introduction:

Serological testing of anti-PRRS antibodies with the IDEXX PRRS 2XR Elisa showed false positive reactors (in expected negative herds; 0,5-2,0 %). Due to this IDEXX developed the PRRS X3 Elisa with improved specifity.

Material:

1. 26 false positive samples (2XR, PCR negative, 16 farms) checked with X3 Elisa
2. 420 sera from PRRS positive herds (n=17) tested in 2XR and X3
3. 388 samples from known PRRS negative herds (n=28) measured in 2XR and X3
4. 10418 monitoring samples (10/2009 -2/2011) from PRRS negative herds (n=48).

Results:

1. From 26 false positive sera (2XR) one serum was positive in X3-elisa (reduction 96 %).
2. The test agreement was 95 % in PRRS positive herds.

PRRS samples	X3 positive	X3 negative
2XR positive	328	11
2XR negative	10	71

3. Samples from known negative herds had 99.2 % congruent results in X3 and 2XR Elisa.

PRRS samples	X3 positive	X3 negative
2XR positive	0	1
2XR negative	2	385

4. 10418 sera (10/2009-2/2011) showed 7 false positive results (0.07 %; 99.93 % specifity).

Discussion:

In the IDEXX X3 Elisa tested samples a reduction of false positive results for >90 % compared to the 2XR Elisa and a specifity of >99 % were observed.

Conclusion:

For testing known PRRS negative herds the IDEXX X3 PRRS-ELISA is a valuable progress due to the significant reduction in false positive sample compared to the 2XR Elisa.

Treatment of a case of trichurosis (Trichuris suis) in pigs

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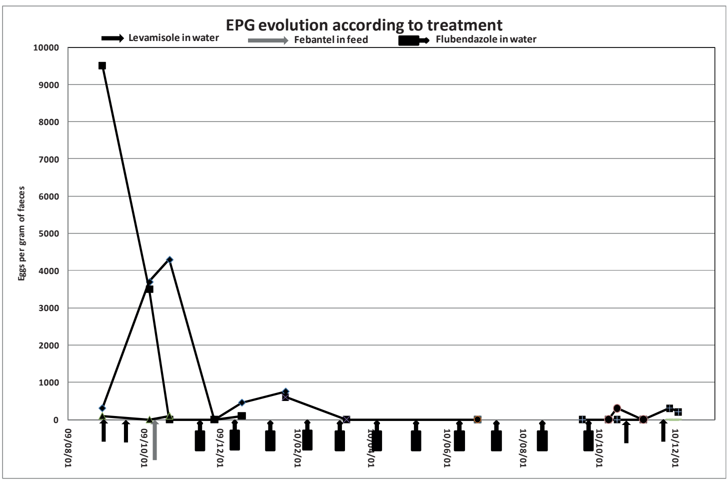
A case of trichurosis was diagnosed in a farrow-to-finish Belgian pig herd. Except in the farrowing room, all pig production stages were kept on or have access to sawdust deep litter. Infrequent renewal of sawdust, continuous pig flow and mixing of fattening pigs from different batches contributed to permanent re-infestation of animals. The infection was associated with severe and persistent diarrhea, growth retardation and even emaciation and anaemia in 10 recently purchased gilts. As there was a good (90 %) clinical response to levamisole given individually per os to gilts (8 mg/kg BW), it was decided to treat groups of affected fattening pigs (showing persistent diarrhea and growth retardation) with the same medication.
This poster reports the effect of consecutive anthelmintic treatments on the evolution of eggs of Trichuris suis per gram of faeces (EPG, determined by a McMaster egg counting technique) collected in 9 batches of fattening pigs (ñ=36), between Augustus 2009 and December 2010. Treatments were based on levamisole in drinking water, febantel in feed or on flubendazole in drinking water and were administrated at 3 to 5 weeks intervals. The quality of administrated treatments was indirectly assessed by a low (<100) EPG for Ascaris suum.
At the beginning of the treatment period, it was difficult to reduce EPG with levamisole or febantel. This situation could be explained by the short administration period of levamisole (4 to 6 hours) or febantel (1 day) compared to flubendazole (5 days). Moreover, drug ingestion could have been impaired by the course of the disease. Thereafter, both flubendazole and levamisole seemed effective to maintain a low EPG.



Serological study in piglets vaccinated and not vaccinated born from vaccinated and not vaccinated sows against PCV2

Esther Maiques[1], Juan [2], Livia Mendonça[2], Juana Maria Abellaneda[2], Juan Manuel Herrero-Medrano[2], García-Nicolás Obdulio[3], Guillermo Ramis[2], Francisco J Pallarés[3], Antonio Muñoz[2], Pfizer Salud Animal. SpainDpt de Producción Animal. Universidad de Murcia. SpainDpt de Anatomía y Anatomía Patológica Comparadas. Universidad de Murcia. Spain

Introduction

Swine practitioners suggest that vaccination of piglets and sows could be a solution for the treatment of PCV2 associated diseases but doubt if could be interference with maternal antibodies (MA). The aim of this study was to evaluate the length of MA in piglets born from vaccinated and not vaccinated sows against PCV2 and to check possible interference with piglets´ vaccination.

Material and methods

20 piglets (10 from vaccinated sows and 10 from not vaccinated sows) were vaccinated against PCV2 at 3 weeks of life. Four groups were established: group 1 (vaccinated piglets from vaccinated sows, n=10), group 2 (not vaccinated piglets from vaccinated sows, n=10), group 3 (vaccinated piglets from not vaccinated sows, n=10) and group 4 (not vaccinated piglets from not vaccinated sows, n=10). Blood samples were obtained from all piglets at 3, 6, 9 and 12 weeks of life and IgG against PCV2 were measured by kit Ingezim circo IgG (Ingenasa, Spain).

Results

Piglets from vaccinated sows had 6 fold more concentration of MA than piglets from not vaccinated sows. MA of piglets from not vaccinated sows suddenly fall at week 6 while in piglets from vaccinated sows fall gradually. All piglets in group 3 were seropositive at week 12 while the percentage of seropositive animals were 60, 90 and 80 in groups 1, 2 and 4, respectively. No increase in the antibodies titer was observed in group 1 during the experiment.

Discussion

Vaccination of piglets from not vaccinated sows produced similar antibodies titer than vaccination of piglets from vaccinated sows. Since an interference with MA was observed, in farm where sows and piglets are vaccinated against PCV2, late vaccination of piglets should be done to avoid the interference.

Research on correlation between animal welfare measures and mortality rate in fattening swine herds in northwest Italy

Giuseppe Martano, Asl TO3 Pinerolo

Introduction : the aim of this study is to evaluate animal welfare conditions and mortality rate in 26 fattening pig herds and assess the respective relationship.

Materials and methods : Data were collected about animal welfare (overcrowding, concentration of ammonia in the air, tail and ear biting prevalence, anomalous behaviours, structure of buildings) and mortality rate in 26 intensive fattening pig herds located in Asl To3 district, northwestern Italy.
The herd's size ranged from 420 to 4050 pigs, for a total of 31.000 pigs.
A survey was performed relating to health practices, status of animal welfare and average mortality rate.
Swine herds were divided into two clusters according to their characteristics;
A: farms with good animal welfare conditions and adequate health care management.
B: farms with inadequate animal welfare measures and with poor health management.

Results :The average mortality rate in cluster A resulted 3,62 % with standard deviation ± 1,46; in cluster B was 5,20 % with standard deviation ± 1,67. Mortality percentage in the single herds in cluster A ranged from to 1,28 % to 5,83 % ; in cluster B ranged from 2,80 % to 9,12 %.

Discussion : The mortality rate was significantly lower (t test, $p<0,05$) in farms with good animal welfare conditions. This shows that it is essential to adopt appropriate measures to improve the state of animal welfare in intensive farms. Breeders to improve the welfare of the animals have a significant economic gain.

Evaluation of Minimum Inhibitory Concentration (MIC) of 18 antibiotics against Salmonella choleraesuis

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Salmonella choleraesuis causes an acute systemic disease in pigs. Antibiotics used for the treatment of the associated disease can be administered by injection or by in feed medication. The choice of the antibiotic should be based on the results of susceptibility tests and pharmacokinetic considerations.
Forty nine Salmonella choleraesuis isolated in Northern Italy during 2009, were tested for susceptibility to 18 antimicrobials by micro-dilution broth method. CLSI clinical breakpoints for Salmonella choleraesuis are available only for ceftiofur and florfenicol. According to these breakpoints, all the isolates resulted susceptible to ceftiofur (breakpoints (µg/ml): S≤2; I=4; R≥8) and 77.6% were susceptible to florfenicol (breakpoints (µg/ml): S≤2; I=4; R≥8). The MIC distribution (µg/ml) was calculated for those antibiotics without a defined breakpoint value. The results are reported in table 1. Low MIC50 and MIC90 values were observed for fluoroquinolones and gentamicin.

Table 1 - MIC50 (µg/ml) and MIC90(µg/ml) values of antibiotics tested against 49 Salmonella choleraesuis isolates

Antibiotic	MIC_{50}	MIC_{90}
Ampicillin	>16	>16
Ceftiofur	1	1
Clindamycin	>16	>16
Chlortetracycline	>8	>8
Danofloxacin	<0,12	1
Enrofloxacin	<0,12	1
Florfenicol	2	>8
Gentamicin	<1	<1
Neomycin	>32	>32
Oxytetracycline	>8	>8
Penicillin	>32	>32
Spectinomycin	64	>64
Sulphadimethoxyne	>256	>256
Tiamulin	>32	>32
Tilmicosin	>64	>64
Tylosin tartrate	>4	>4
Trimethoprim/Sulfamethoxazole	>2/38	>2/38
Tulathromycin	8	16

Five years (2006-2010) results of wild boar (Sus scrofa) sanitary monitoring in Emilia-Romagna region (Northern Italy)

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The study reports the results of a 5 years (2006-2010) monitoring program of hunted wild boar (Sus scrofa) implemented in Emilia-Romagna region, a high density pig populated area in Northern Italy. Samples from 39,302 wild boars were collected during 5 hunting seasons. Blood sera were analysed for the presence of antibodies against Swine Vesicular Disease Virus (SVDV), Classical Swine Fever Virus (CSFV) and Aujeszky's Disease Virus (ADV); samples of muscular tissue were examined for the presence of Trichinella spp. larvae and Toxoplasma gondii (PCR and ELISA on meat juice); viscera were analysed for Mycobacterium spp. and Brucella spp. No antibodies against CSFV (0/9,386) and SVDV (0/8,503) were detected. Conversely 2,425 out of 8,238 sera were positive to ADV. The ADV prevalence rates were 31.9, 35.2, 21.6, 31.3 and 31.7% in 2006, 2007, 2008, 2009 and 2010, respectively. Seroprevalence against Toxoplasma gondii was 19%. Trichinella pseudospiralis larvae were detected in 1 out of 39,302 muscolar tissue samples. Mycobacterium tuberculosis Complex by PCR was demonstrated in 6 of 414 samples. Isolation and typing of the strains is ongoing. Brucella spp. has been evidenced by PCR in 8/403 samples. In three samples Brucella suis biovar 2 has been successfully cultured and identified. Although, as expected, there are no evidences of SVDV and CSFV circulation in the wild boar population, the presence of ADV, Brucella suis and Toxoplasma spp. suggests maintenance and implementation of biosecurity measures in order to prevent the contact between wild boars and domestic confined pigs.

Efficacy of piglet vaccination with CIRCOVAC® in five Spanish farms

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Introduction

The objective of this study was to confirm that PCV2 vaccination with CIRCOVAC in piglet could improve the performance parameters under Spanish conditions.

Materials and Methods

The study included 5 Spanish farrow-to-finish farms where piglets are weaned at 21 days of age and moved to the finishing units, after 5 to 6 weeks in a nursery.

Table 1: Production type and farm size

Farm	N° of sows	Total N° of piglets monitored	Clinical diagnosis	Lab conf. Pathol.
A	500	1,472	Yes	Yes
B	200	4,404	Yes	No
C	400	13,726	Yes	No
D	400	5,787	Yes (sub-clinical)	Yes
E	550	2,050	Yes	Yes

Table 2: Mortality and runt rates results in farms

Farm		Pig in V & C groups	%mortality nursery	% mortality fattening	% runts	ADWG	FCR
A	C	1092	20.6 [a]	-	8.8 [a]	-	-
	V	380	8.2 [b]	-	3.4 [b]	-	-
B	C	2613	2.6 [a]	4.5 [a]	7.7 [a]	-	-
	V	1791	2.3 [a]	3.8 [a]	1.0 [b]	-	-
C	C	7631	4.2 [a]	12.5 [a]	-	-	3.1
	V	6095	2.2 [b]	4.4 [b]	-	-	2.85
D	C	3786	2.9 [a]	4.1 [a]	-	-	-
	V	2001	1.7 [b]	3.1 [b]	-	-	-
E	C	998	-	10.9 [a]	18 [a]	0.493	2.826
	V	1052	-	2.4 [b]	7 [b]	0.694	2.394

([a, b] figures with different superscripts in the different groups in each farm are statistically differing, Chi-square test, $p<0.05$).

All farms were clinically PCVD and serologically PRRS positive. PCVD status was lab-confirmed in the 3 farms by specific lesions and IHC.

In each farm, piglets were divided into 2 groups:
- the control non-vaccinated group (C)
- the vaccinated group (V) was injected intramuscularly with a 0.5 ml of CIRCOVAC, once at 3-4 weeks of age. Piglets were born from non-vaccinated sows.

Results

Although the PCVD form was considered as sub-clinical in farm D with a rather low mortality, the mortality rates in nursery and finishing were significantly decreased.

Discussion and Conclusion

Piglet vaccination with CIRCOVAC led to significant improvement of mortality rate in the nursery (farm A, C and D) and fattening period (farm C, D and E) and a significant reduction of the runt rates (farm A, B and E).

This large study including more than 27,000 piglets demonstrates the positive impact of CIRCOVAC piglet vaccination on performance data in pig producing farms in Spain.

®CIRCOVAC is a registered trademark of Merial in the United States of America and elsewhere.

Impact of CIRCOVAC® vaccination in an integrated system suffering from PRDC and wasting pigs

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Introduction

The objective of this paper is to assess the impact of PCV2 vaccination in piglets on productivity in an integrated system experiencing wasting and respiratory symptoms both in weaners and fatteners in spite of having implemented exhaustive PRRS control measures.

Materials and Methods

Average production performances of the fattening periods of 44 consecutive batches of fatteners issued from one single 1200-sow herd, were recorded. Only fattening units receiving piglets from a single source were included in the analysis.

Respiratory symptoms and delayed growth were observed in this system for a long period before PCV2 vaccination was applied in spite of the implementation of specific PRRS control measures that only partially improved the results.

PCVD were diagnosed from 3 piglets, as previously described (1). In the vaccinated groups, all piglets were vaccinated IM at weaning with 0.5 ml of CIRCOVAC.

Average of production parameters have been compared using parametric (Student-T test) or non parametric (U of Mann Whitney) tests after performing a test of normality (Kolmogorov Smirnoff).

Results

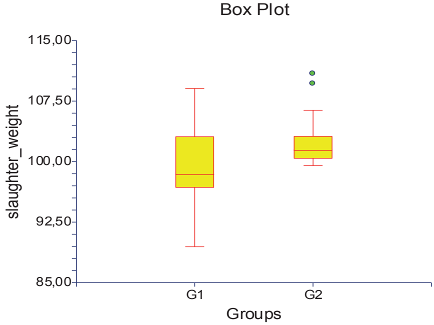
Laboratory results indicated a subclinical infection of PCV2.

Table 1: Productivity results in the 44 fattening batches

	Before vaccination	During vaccination
Period	21/03/08-05/05/09	20/05/08-13/04/09
Number of batches (Number of pigs)	23 (13,892)	21 (15,800)
Av. Number of pigs at entry (Min.-Max.)	604 ± 144.6 (330-940)	752±133.1 (620-1000)
Av. Weight at entry (rank)	17.82±1,6 (15.78-23.32)	18.15±1.3 (15.65-21.10)
Av. Days on feed (rank)	139.4 ±6.1 (131-151)	133.9±6.5 ** (122-152)
Mortality rate (%) (rank)	16.1 (9.6-23.3)	6.5 (3.3-9.9)***
Feed conversion rate (FCR, kg/kg)	3,13±0.21 (2.89-3.50)	2.88±0.17 (2.63-3.14)**
Corrected FCR (kg/kg)	3.12±0.22 (2.81-3.55)	2.85±0.17 (2.61-3.11)**
Average Daily Weight Gain (ADG, g/day)	0.595±3.17 (0.555-0.676)	0.636±2.82 (0.587-0.691)***
Av. Slaughter weight (kgs.)	99.87 ±4.76 (89.45-109.03)	102.40±3.08 (99.50-110.86)*
Cost of medication (€/kg l.w.)	4.86±2.83 (2.0-10.8)	1.82±0.55 (0.5-3-0)***

*p<0.05; **p<0.01; ***p<0.001

Figure. 1: Box and whisker plot of the slaughter weight of the control (G1) and vaccinated animals (G2)



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Discussion

Mortality rate fell after vaccination from 16.1% to 6.5%.
Deaths in vaccinated animals were caused by infectious agents not related to PCV2.
A clear cut improvement was observed in the herd since the first vaccinated batch and remained.

The ResPig program as a tool for identifying risk factors affecting technical performance and post-mortem results at the slaughterhouse on Dutch pig farms and sero prevalence of infections.

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Introduction

The pig industry nowadays faces complex diseases such as Porcine Multi Systemic Wasting Syndrome and Porcine Respiratory Disease Complex. These disease entities are often caused by multiple infections combined with suboptimal conditions. The presence of risk factors for infectious diseases often results in the use of preventive and curative antibiotic treatments that allows the development and selection of more antibiotic-resistant bacteria (1). ResPig is a digital diagnostic and monitoring program for veterinarians with regular cross-sectional serological investigations for the presence of PRRSV, PCV2, Actinobacillus pleuropneumoniae, Mycoplasma hyopneumoniae, Influenza and Haemophilus parasuis. It also includes an objective scoring system for possible risk factors (environment, management, housing, biosecurity) on different respiratory problems. The program helps the veterinarian towards a structured approach to prevent respiratory disease with restrictive use of antibiotics. Because of the high number of participating farms and the standard sampling protocols it is possible to analyze the epidemiology of infections on participating farms by sero-prevalence and to determine relations between the presence of infectious as measured by serology and technical- and slaughterhouse performance parameters of finishers as presented in this study.

Material and methods

1. In 2008-2009, three-hundred farms were sampled cross-sectionaly (sows, replacement gilts, 5-, 10-, 16-and 22-weeks old pigs, 5 animals per group) with a total of 936 investigations. During this time (2008-2009), performance data (average daily gain (ADG), mortality), slaughterhouse results and vaccination history was recorded. Odds ratios were calculated between the presence of infectious and technical and slaughterhouse results. Definitions for the technical- and slaughterhouse performance were taken from the farm comparison 2008-2009 of Agrovision's management system (calculates the average performance of Dutch pig farms) (2) and VION farmingnet slaughterhouse scores for 2008. These definitions are listed in Table.1 together with serological definitions.

Table 1:defintions

def.:	sampl.	result
App +	average titer	≥ 14 omp elisa*
PRRS +	average titer	>0.4 idexx elisa
M hyo +	% sampl+	> 20% idexx elisa
Infl +	average titer	≥ 9 log2 HI
PCV2 +	average titer	≥ 10 log2 int.elisa

tech.-/slaughterhouse	result
high mortality	>2.5%
sub optimal ADG	<786 gr
high pleuritis	≥16.5%
high pneumonia	≥11.7%

*antibody Elisa on the 42 kD outer membrane protein of A. pleuropneumoniae (3)

2. Sero-prevalence of PRRS, PCV2, A. pleuropneumoniae and M. hyopneumoniae of the same farms was calculated for 10-weeks-old pigs and 22-weeks-old fatteners. When all 5 tested pigs were negative the investigation was considered as negative.

Results

1.Table 2: Relationships: odds ratio betw een serology and peformance results

serology	techn. / slaughter results	O.R.*	P
App +	high pleurisies	4.7	(< 0.0001)
	high pleurisies + pneumonia	4.3	(< 0.0001)
PRRS +	high pleurisies	8.O	(= 0.0029)
	high pleurisies + pneumonia	6.2	(= 0.0028)
PCV2 +	sub optimal ADG	1.9	(= 0.0425)
M hyo +	high mortality	2.9	(= 0.0014)

* Significant associations (P<0.05) P-value based on Fisher's exact test

2.Tabl 3. seroprevalance infections of farms (2008-2009)

	piglets 10 weeks	fatteners 22 weeks
	% investigations (all samples tested negative)	% investigations (all samples tested negative)
PRRS (idexx)	55.4% (514/927)	13.2% (79/595)
App (omp elisa)	24.0% (223/929)	2.2% (13/598)
PCV2 (in house elisa)	2.4% (6/391)	1.5% (6/391)
M hyo (idexx elisa)		42.3% (251/593)

Conclusions and discussion

Several significant relations were found as listed in table 2. As expected, the presence high A. pleuropneumoniae-OMP titers was related with high pleurisy scores since A. pleuropneumoniae is a major cause of pleurisy. More surprising, also PRRS was a risk factor for pleurisy at slaughter, possibly due to co-infections with other secondary infections. Positive M. hyopneumoniae serology was a risk factor for high mortality in finishers. Early infections and disturbances in the clearance mechanism and integrity of the upper respiratory tract could be a possible reason. High PCV2 titers in finishers were a risk factor for suboptimal Average Daily Gain (ADG). Serology as used in the ResPig protocols, together with disease history and technical-/slaughterhouse results makes it possible to identify infections that lead to poor results in technical performance during finishing and in slaughter scores. This helps the veterinary adviser to develop more successful preventive programs. Moreover, continuous monitoring of infections on a farm or in an area (table 3.) by ResPig makes benchmarking possible and gives additional information regarding the efficacy of different preventive strategies.

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Comparative efficacy of piglet vaccination with CIRCOVAC® versus another PCV2 piglet vaccine under Portuguese condition

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Introduction

Porcine circovirus diseases (PCVD) have been shown to be controlled by CIRCOVAC vaccination in sows and piglets. PCV2 vaccination of piglets is frequently used as an indirect field diagnosis tool to confirm a blur impact of PCVD. The objective of this randomized and blinded trial was to compare the efficacy of CIRCOVAC versus another PCV2 piglet vaccine.

Materials and methods

Five weekly piglet batches were involved. At 25 days of age (weaning), half of each litter was randomly allocated to groups vaccinated with 1 dose of one of the two vaccines (CIRCOVAC or vaccine A). Pigs from the two experimental groups were housed co-mingled, but sorted by sex and weight. Mortality was recorded. Weaning-to-slaughter durations ranged from 166 and 204 days (no average duration available) in the experimental pigs. Average weaning weights (no individual weighing) were obtained by group weighing and average carcass weights obtained at the slaughter house. Mortality rates were statistically compared using Chi^2 test.

Results and conclusion

During fattening, the vaccinated pigs experienced less digestive problems (no difference between both vaccinated groups). A decrease on the injectable antimicrobials costs was observed in the vaccinated groups. Mortality records showed similar mortality with a tendency to a bit less mortality for the CIRCOVAC group. In conclusion, CIRCOVAC and Vaccine A did bring clinical improvement and similar reduction of mortality.

Table 1: Farm characteristics

Number of sows	550
Type of operation	farrow-to-finish
weaning-slaughter mortality rate	8,9%
clinical picture	evocative of PCVD (wasting, delayed growth and heterogeneity)
PCVD Diagnosis	Clinical suspicion was established clinically but no lab confirmation.
Other pathogens identified	PRRS+, M hyo+
Other noticeable health issues	intermittent digestive disorders

Table 2: Mortality and raw growth data in the 2 vaccinated groups

Farm S	Before PCV2 vaccination	CIRCOVAC	Vaccine A	delta %	Chi2 (p)
Weaned piglets n		740	740		
Mortality rate post weaning	5.1%	2.7%	3.9%	-1.2%	0.191
Mortality rate fattening	4.0%	2.5%	3.5%	-1.0%	0.260
Mortality rate farrowing-slaughter	8.9%	5.1%	7.3%	-2.2%	0.085
Weaning b.w. (kg)		6.5	6.5	0.0	
Slaughter carcass weight (kg)		91.7	90.5	1.2	

Presence of methicillin resistant Staphylococcus aureus (MRSA) on pig carcasses surface at the end of the slaughtering process.

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Methicillin resistant Staphylococcus aureus (MRSA) has been found in pigs and there are many evidences of transmission from pig to humans. The potential of human infection by pork meat is controversial.

The aim of this study was to evaluate the presence of MRSA on pig carcasses at the end of the slaughtering chain.

Three MRSA colonized herds, were enrolled in the study. At slaughter-house sixty nasal swabs per herd were taken immediately after jugulation and twenty samples were gathered using sterile dry swabs (Sodibox®) from the skin of the throat region at the end of the slaughter line, just before cutting or chilling. All samples were cultured for MRSA, nasal swabs were cultured in pools of ten each.
Six pools of nasal swabs (100%) resulted positive in two herds and three (50%) in the other one. At the end of the slaughter line, before cutting or chilling, carcasses surface resulted contaminated by MRSA with a prevalence of 20%, 45% and 40% respectively.

Genotyping of isolates is in process in order to evaluate the homology/heterogeneity within isolates from nasal swabs and from carcasses.

These results provide evidence of MRSA contamination of pig carcasses from naturally colonized herds, at the end of the slaughter line. Further investigations are needed in order to better understand the risk of human colonization through the food chain.

PCV2 infection dynamics and production parameters in a PCV2 double vaccination (sow and piglets) schedule

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A field trial was designed to study the effect of PCV2 double vaccination (sows and piglets) on PCV2 viremia, serology and productive parameters. One week before mating, 26 and 31 sows were injected with 2 ml Porcilis PCV® and 2 ml PBS, respectively. At weaning, 476 healthy piglets were distributed into 2 groups. From each sow, half of the litter was vaccinated with Porcilis PCV® and the other half non-vaccinated (PBS), obtaining 4 study groups: non-vaccinated sows-non-vaccinated pigs (NV-NV, n=134), non-vaccinated sows-vaccinated pigs (NV-V, n=135); vaccinated sows-non-vaccinated pigs (V-NV, n=104); vaccinated sows-vaccinated pigs (V-V, n=103). Blood samples from 75 piglets of each group were taken at 3-4 (weaning), 8, 12, 16, 21 and 26 weeks of age and tested by PCV2 IPMA and PCR. Weight was recorded from all the animals at weaning and 12, 16, 21 and 26 weeks of age. Mortality was registered throughout the trial. Results showed that a single vaccination in sows before mating induced high antibody titres to their piglets at weaning and a delay in PCV2 infection compared to piglets coming from NV sows. Piglet vaccination (independently of sow treatment) caused an earlier seroconversion, a lower percentage of PCV2 infected pigs as well as an improvement in weight, ADG, mortality rates and homogeneity of the batch at slaughter age compared to the NV piglets. Double PCV2 vaccination strategy reduced PCV2 infection and achieved the best production parameter results (not significantly different from NV-V ones), but caused some interference in piglet humoral vaccine-elicited response.

PCV2 infection and seroconversion patterns in PCV2 vaccinated and non-vaccinated pigs coming from vaccinated and non-vaccinated sows

Marina Sibila[1], Lorenzo Fraile[2], Miquel Nofrarías[1], Rosa López-Jimenez[1], Sergio López-Soria[1], Diego Pérez[1], Eva Huerta[1], Anna Mª Llorens[1], Alex Eggen[3], Joaquim Segalés[1,4], Centre de Recerca en Sanitat Animal (CReSA), Spain Universitat de Lleida, Spain Intervet Schering/Plough International BV, The Netherlands Departament de Sanitat i d'Anatomia Animals, Facultat Veterinaria. UAB, Spain

PCV2 vaccination has become a major practice in pig farms worldwide due to its great efficacy. However, levels of maternal immunity and viremia of the piglet at the time of vaccination may affect PCV2 infection dynamics of vaccinated population. Therefore, the objective of this work was to analyse the different PCV2 infection and seroconversion patterns in a population of pigs vaccinated (Porcilis PCV®) and non-vaccinated against this virus, coming from vaccinated and non-vaccinated sows. A total of 476 healthy piglets from vaccinated (Porcilis PCV®) and non-vaccinated sows were distributed into 4 groups: non-vaccinated sows-non-vaccinated pigs (NV-NV, n=134), non-vaccinated sows-vaccinated pigs (NV-V, n=135); vaccinated sows-non-vaccinated pigs (V-NV, n=104); vaccinated sows-vaccinated pigs (V-V, n=103). Blood samples from 75 piglets of each group were taken at 3-4 (weaning), 8, 12, 16, 21 and 26 weeks of age and tested by PCV2 IPMA and PCR. A cluster analysis of PCV2 antibodies and PCR results was done. Four different profiles were obtained: 1) PCV2 non-infected animals with medium and high IPMA titres through the trial (mainly from NV-V and V-V treatments); 2) PCV2 viremic piglets with an increasing antibody levels against this virus over the time (mainly NV-NV treatment); 3) animals with late PCV2 infection as well as seroconversion (mostly from V-NV treatment); and 4) animals with a decreasing PCV2 antibody titres with occasional viremia (mainly from V-V and NV-V groups). These results indicate that different subpopulations of animals in regards PCV2 viremia and antibodies co-exist within each treatment group.

Effectiveness of sow vaccination with CIRCOVAC® (Merial) in a PCV2-positive but PCVD-free herd under Italian conditions

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Introduction

The objective of this study was to assess the efficacy of CIRCOVAC sow vaccination, in reducing mortality and improving growth of the offspring, in a PCV2 positive, PMWS negative herd (absence of PCVD), under Italian conditions.

Materials & Methods

Farm: 170-sow farrow-to-finish farm using a 3-week farrowing batch management. PCV2 presence was confirmed from previous serological monitoring but no clinical signs of PCVD were observed.

Vaccination:

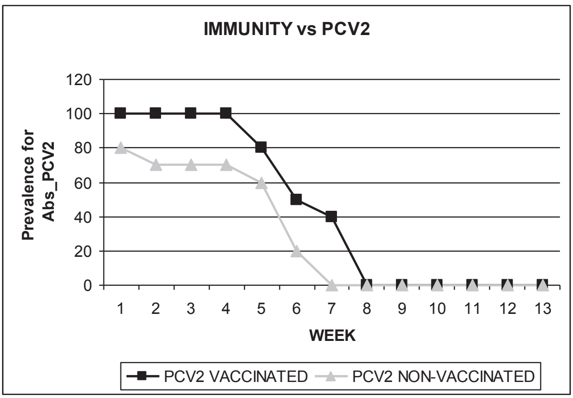
Batches 1, 3 and 5 of sows were vaccinated: CIRCOVAC, 2mL IM, 40-50 days before farrowing and a second shot 20 days before farrowing.
Batches 2, 4 and 6 were used as controls.

Investigations:

- Mortality in piglets for the 6 groups.
- Weight of 50 animals at weaning and one week before slaughtering.
- Presence of PCV2 antibodies by ELISA tested from serum of ten pigs randomly selected from the progeny of batches 1 and 2.

Results

Figure 1: Percentage of piglets with PCV2 antibodies detected in serum in experimental groups



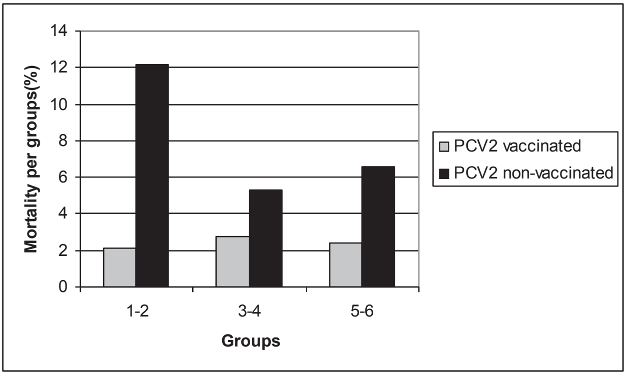
* Statistical significance, $p<0.05$, Mann-Whitney test confirmed by Kruskal-Wallis test.

Table 1: Growth results

	Non-vaccinated	Vaccinated
ADWG (kg) Weaning – 68D	0.36±0.08	0.33±0.04
ADWG (kg) 68D – 120D	0.52±0.03	0.63±0.09
ADWG (kg) 120D - Slaughter	0.72±0.04	0.77±0.07

Mortality was statistically lower in the vaccinated group: 2.42% vs 7.82% (p<0.0001).

Figure 2: Batch mortality



Discussion

Sow vaccination with CIRCOVAC, induced a significant improvement in overall piglet (1142) mortality rate. An increase of the ADWG was seen from 68 days to slaughter.

The longitudinal seroprofiles obtained for the pigs belonging to the two experimental groups showed a better transfer of maternal immunity to the piglets of the vaccinated dams.

A comparison of different PCV2 vaccines given to piglets

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Introduction
The purpose of this trial was to compare two different PCV2 vaccines given to piglets on a farm with a high disease burden in the rearing herd.

Materials and Methods
Farm
- 750 sow farrow-to-finish unit in Eastern England.
- Significant disease burden: PCVD, PRRS, Actinobacillus pleuropneumoniae, Mycoplasma hyopneumoniae and secondary bacterial infections.
- Experienced:
  - o high levels of respiratory disease,
  - o wean to finish mortality of 8%,
  - o poor growth rates,
  - o high levels of treatment.
- Control measures used:
  - o PRRS-MLV and PCV2 vaccination of sows and pigs,
  - o Mycoplasma hyopneumoniae vaccine for pigs,
  - o antibiotic treatments.

Trial:
Piglets from each litter were randomly allocated into 2 groups, and were vaccinated at weaning (23-25 days of age).
- Group V: 0.5ml CIRCOVAC® (Merial) IM,
- Group F: 1.0ml CIRCOFLEX® (Boehringer Ingelheim) IM.

Results
No adverse reactions were observed following the administration of either vaccine. In the entire trial group clinical disease was at better levels than normal, but one outbreak of Actinobacillus pleuropneumoniae occured during the trial. This was controlled by individual injection with Ceftiofur and water medication with Amoxycillin.

Table 1: Average Daily Gain in gms

	Group V	Group F	Student T-test
Number of pigs	344	353	
ADG Wean to Finish	540	536	NS
ADG Wean to Grower	436	436	NS
ADG Grower to Finish	593	585	NS

NS: Non Significant

The main cause of death in both groups was Actinobacillus pleuropneumoniae.
No deaths were attributed to PCVD.

Table 2: Weaning-to-finish mortality rate

	Group V	Group F	Chi2
Mortality rate	3.5%	4.5%	NS

NS: Non Significant

Discussion

This trial shows that there was no significant difference in growth rates and mortality levels between piglets vaccinated with 0.5ml CIRCOVAC or 1.0ml CIRCOFLEX. Marginal benefits for CIRCOVAC were observed.

Economic benefits of the control of sarcoptic mange in fattening pigs under Italian conditions

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Introduction

The aim of this study was to evaluate the productivity improvement and the economic benefits of IVOMEC® PREMIX (Merial) in the control of sarcoptic mange in an herd producing Italian ham (Parma and San Daniele).

Materials and Methods

The farm produced around 25,000 slaughter pigs per year.
- Pigs entered at 35-40 kg and stayed 40 days in a separate site. At entry, all animals were treated with benzimidazoles.
- At 50-60 kg, pigs were moved to a 2nd site up to slaughter (150-160 kg).

Pigs were treated with IVOMEC PREMIX (100 mg/kg live weight (LW)/day for 7 days) at entry in fattening units.

Evaluation The treatment efficacy was evaluated by ear scraping (ES) and feces analysis (FE) for internal parasites in live and slaughtered animals. The average dermatitis score (ADS) was measured at slaughter (1).

The economic improvement was calculated based on the live weight difference (g) between the 2 groups multiplied by market value updated with February 2010 data (€).

Results

Table 1: Sarcoptic mange analysis results

	Control group		Treatment group	
	Start Jun. 2002	End Nov. 2002	Start Jun. 2002	End Nov. 2002
ADS (positive>0.5)	/	0.77	/	0.35
ES	7/30 [a]	16/30 [b]	12/30 [c]	0/30 [d]
FE	0/30	0/20	0/30	0/20

[a, b] ($p=0.034$); [c, d] ($p<0.001$), Chi-square test

Table 2: performances and economic results

	Control group	**IVOMEC PREMIX group**
No of pigs	519	520
Total group bodyweight at start (kg)	29,760	29,470
Mean individual bodyweight at start (kg)	57.34	56.67
No of pigs slaughtered	491	500
No of dead pigs	17	14
No of wasting pigs	11	6
Total group slaughtered and wasting pigs bodyweight (kg)	81,405	83,340
Mean individual slaughtered and wasting pigs bodyweight (kg)	162.16	164.70
Total group increase of bodyweight during fattening period (kg)	51,645	53,870
Total group bodyweight increase in IVOMEC group (kg)	-	+ 2,225
Total group additional economic benefit		€ 2,752.3[1]
Additional economic benefit per pig		€ 4.88

[1]bodyweight increase (kg) x 1.237 € (quotation of slaughtered pigs in February 2010 in Italy)

Discussion

This controlled, blinded and randomized study showed that Sarcoptes can infest pigs up to slaughter (9-10 months of age).

The results confirmed the high efficacy of IVOMEC PREMIX in the control of sarcoptic mange (1).

The economic benefit of IVOMEC PREMIX treatment was 4.88 € per pig.

References

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Clinical chemistry in non treated boars and boars vaccinated with Improvac® at different ages and times after 2nd vaccination

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Objectives

Vaccination of boars with Improvac® is a successful and animal friendly alternative to surgical castration. The objective of the study was to determine selected clinical chemical parameters of the protein and mineral metabolism at the time of slaughtering in boars and boars vaccinated with Improvac® that went to slaughterhouse at different ages and times after 2nd vaccination.

Material and Methods

569 blood samples were collected during exsanguination from 140 boars (from 26 to 29 weeks of age) and 429 Improvac® vaccinated boars the same age. Improvac® treated animals received 2nd vaccination 5 to 10 weeks prior slaughter. Alkaline phosphatase (AP), urea, creatinine, inorganic phosphate (P) and calcium (Ca) were analyzed in blood serum.

Results

Urea was significantly higher (median 6.3 to 7.3 mmol/l) in Improvac® vaccinated boars than in boars (5.4 to 5.8 mmol/l) the same age. AP, on the other hand, was significantly lower (128 to 148 U/l) in vaccinated boars than in boars (139 to 184 U/l) the same age. No age dependency was detected in both parameters. Creatinine increased significantly age dependent from 133 to 149 µmol/l in boars but stayed at the same high level (around 150 µmol/l) in vaccinated boars. No significant differences were detected in Ca and P.

Discussion

Parameters of the protein metabolism were age dependent in boars and differed from those of Improvac® vaccinated boars. The differences should be considered relevant for feeding and food ingredients of boars and Improvac® treated boars.

Effect of vaccination against gnrh with improvac®, on performance parameters and body composition under field

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The objective of this study was to evaluate the effect of vaccination against GnRH on performance traits as well as body composition of pigs under commercial farming conditions. A total of 592 cross-bred pigs (male, and gilts) (112 castrated males, CM); 168 males to be vaccinated with Improvac, IM); and 312 females, F) included into the trial. Animals of CM group were castrated at the age of 3 days. The two vaccinations (Improvac®) were applied at a mean age of 84 and 129 days of age.
After weaning animals were kept in groups of 45 and during fattening in groups of 50 animals/ pen recording individual pen feed intake. All pigs were fed the same farm-made diet depending on the growth phase. At the beginning of each stage of the cycle – at weaning (d.21) at the age of transfer to fattening phase (d.83) and on the day of slaughter (d.168) animals were weighed in groups of 7 to 10 animals. At the day of slaughter backfat thickness (FT) and loin-muscle depth (LD) were also recorded ultrasonically. During growing phase IM animals presented a lower growth rate compared to CM and F ($P < 0.05$), whereas in the fattening phase their growth rate compared was significantly higher ($P<0.05$). IM food consumption was lower by 7.06% and by 1.23 % lower as for CM and F animals. Final lean meat percentage of F was 56.85%, for IM 55.5% and for CM was 53.1 %. Results from this study indicate that vaccination against GnRH, improves productive parameters of the fattening pigs.

Facilitating nursing behavior of sows at farrowing has a positive effect on piglet development

Jan Jourquin, Lieve, Goossens, Janssen Animal Health

Sow behavior during early lactation has an impact on the colostrum distribution. Nursing behavior can be improved with azaperone, a sedative registered for pigs. In a multi-center field trial, the impact of an azaperone injection of the sow on piglet development until weaning was evaluated.
998 sows from 11 farms were randomly spread over parities and azaperone treated or left untreated. The treatment was an IM injection of 320 mg azaperone (8 ml Stresnil®) at expulsion of the placenta. The live born piglets were weighed and indentified at birth and weaning. Mortality, weaning weight, litter weight gain and percent of piglets reaching 6 kg at 24 days were the main parameters. Mixed models were used for statistical analysis.
An overview of the results is shown in table 1.

Table 1: Results

	Azaperone	Untreated	p-value
Number sows	502	496	
Piglets alive at start	11.72	11.62	
Birth weight (kg)	1.39	1.41	
Piglets weaned	10.25	10.18	
Mortality (%)	12.6%	12.4%	p>0.05
Weaning weight (24d) (kg)	6.84	6.71	p<0.02
% piglets reaching 6 kg at 24d	70.6%	66.5%	p<0.01
Litter weight gain (24d) (kg)	53.54	51.73	p<0.04

Piglets of the treated group consistently grew faster (+6 g/day) independent of birth weight. In farms with also a mortality decrease, more light weight piglets (< 1 kg) survived (71.5% versus 60.9%), neutralizing but not reversing the growth advantage. The effect is bigger in younger parities.
Improved nursing behavior of the sow during the colostrum phase results in a better development of her litter until weaning.

PK/PD integration of tiamulin (Denagard®) by injection against mycoplasmal joint infections

David Burch[1], Ulrich Klein[2], Octagon Services Ltd Novartis Animal Health Inc.

Introduction

Tiamulin injection (Denagard® – Novartis AH Inc.) has been used for the treatment of mycoplasmal arthritis caused by M. hyosynoviae (MHS) and M. hyorhinis (MHR). It was the purpose of this study to compare the pharmacokinetics (PK) of tiamulin in joint fluid with the pharmacodynamics (PD) or minimum inhibitory concentrations (MIC) of the mycoplasmas involved.

Materials and method

Pharmacodynamics: Tiamulin's activity against MHS and MHR (Hannan et al, 1997) is summarised in Table 1.

Table 1. Susceptibility of various mycoplasma strains to tiamulin

Species	No isolates	MIC 50 (μg/ml)	MIC 90 (μg/ml)	MIC range (μg/ml)
MHS	18	0.005	0.025	0.0025-0.1
MHR	20	0.1	0.25	0.025-0.5

Goodwin (1985) showed that the minimum bactericidal concentration (MBC) was approximately 2 times the MIC for MHS and 1 for MHR.

Pharmacokinetics: Tiamulin is primarily a bacteriostatic and therefore the area under the curve over 24h (AUC 24h) was considered the most suitable PK parameter to use. McKellar et al (2004) demonstrated that the AUC 24h for tiamulin in plasma was 8.79μg.h/ml following an injection at 15mg/kg bodyweight. Combined data from McKellar et al (1993) and Skov & Nielsen (1988) showed that there was an average joint fluid concentration at 40% of the plasma concentration giving an AUC 24h of 3.52μg.h/ml.

Results and discussion

Table 2. Results of PK/PD integration for tiamulin using AUC24h / MBC (= MIC x MBC/MIC ratio)

Species	AUC 24h joint fluid	MBC 50	MBC 90	AUC/MBC 50	AUC/MBC 90
MHS	3.52	0.01	0.05	352	70
MHR	3.52	0.1	0.25	35	14

Using ≥100 AUC/MIC (= MBC) ratio for bactericidal antimicrobials (Toutain, 2003) and ≥24 AUC/MIC ratio for bacteriostatic inhibitory antibiotics, tiamulin injection would appear to exert primarily an inhibitory effect at a dose of 15mg/kg bwt against MHR at the MBC 50, but a strong mycoplasmacidal effect against MHS's MBC 50. The efficacy was confirmed clinically by Burch & Goodwin (1984), markedly reducing lameness in gilts caused by MHS and Talummuk et al (2010) in nursery pigs affected with MHR polyarthritis, following treatment with tiamulin injection.

References

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Ulna epiphyseolysis by housing deficiencies in nursery pigs-a case report

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Introduction
This case report from a new established piggery (1.700 sows, 7.000 weaners) demonstrates in addition to a former observational study (1), that extreme housing failure can cause ulna epiphyseolysis already in nursery pigs.

Materials and Methods
On herd investigation focused on disease frequencies, housing and feeding. Further examinations were performed in 4 selected cases and 5 controls.

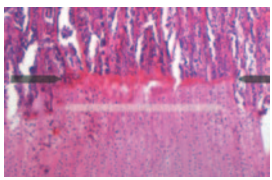
Results
From weaning (day 21) to delivery (9 weeks later) frequencies of forelimb weakness and lameness increased steadily to 40 %. Side-symptoms were slipping on a wet surface of the fully slatted plastic floor due to splashed liquid feeding 10times a day, or standing predominantly on the claw cleft due to bars of 8 and slats of 13 mm (a). Living space was 0.17 m2/ pig. Cases demonstrated bilateral carpal flexions, convex deviations of the forearm, spreaded claws (b) and an average daily weight gain of 503 g vs. 330 g in controls. Blood examinations were without significant findings. Radiography demonstrated in cases bilaterally widened epiphyseal lines of the ulna with radiolucent zones in the adjacent metaphysis (c). Histology already showed in controls (age 7 weeks) segmental thickening of the hypertrophic zone with retention of cartilage extending into the metaphysis (d). In cases (age 11 weeks) fissure formation appeared as a result of chondrocyte necrosis.

Discussion
Fast growing and housing in disagreement with the Pig Husbandry Law (2) are the basis for pathogenesis of growing cartilage dyschondroplasia. Immediately, restricted feeding, and an early reconstruction of housing is recommended for such problem herds.


a


b


c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Microbial etiology of infectious arthritis in nursing piglets

Marie Sjölund[1], Maria Lindberg[2], Helle Ericsson Unnerstad[1], SVA National Veterinary Institute Swedish Animal Health Service

Approximately 10% of nursing piglets in Sweden are affected by arthritis and will consequently be treated with antimicrobials. However, little is known of the etiological cause. Therefore, this study was conducted to identify the bacterial pathogens associated with arthritis in nursing piglets to provide a basis for an optimal treatment regime.

One nursing piglet with clinical signs of arthritis from herds with ≥100 sows (n=113) were euthanized and stored at -20°C before being submitted for necropsy. At necropsy, two affected joints per piglet were sampled for bacterial cultivation. Antimicrobial susceptibility was determined by broth microdilution using VetMIC™ (SVA, Uppsala). Epidemiological cut-off values according to EUCAST were used to determine resistance (www.eucast.org). Isolates of Staphylococcus hyicus were examined for penicillinase production by the "clover-leaf" method.

The preliminary results obtained from 113 piglets, demonstrated bacterial isolation from 111 of 226 sampled joints (Table). The dominant finding was Streptococcus equisimilis, isolated from 72 joints. Mycoplasma spp. and Haemophilus spp. could not be isolated. All streptococci were susceptible to penicillin. However, 12 of 19 S. hyicus isolates were penicillinase producers which would imply some cases of treatment failure using penicillin. All E. coli and all S. hyicus isolates were susceptible to trimethoprim.

In this study, treatment with penicillin would potentially be successful in 57 of 79 piglets suffering from arthritis. Consequently, penicillin should be considered the drug of choice and trimethoprim-sulphonamides the second hand choice for treating infectious arthritis in nursing piglets.

Table. Bacterial cultivation from 226 joints from 113 nursing piglets with lameness. The table shows the microbial findings and sensitivity to the drug of choice for treating arthritis. If resistance to the drug of choice was found, the sensitivity to the second choice antimicrobial was analyzed.

Microbe	Isolated from		Total number of isolates	Sensitive to		
	2 joints per pig	1 joint per pig		Penicillin	Trimethoprim	at least one of the drugs tested
Strept. equisimilis	24	24	72	72 / 72	-	72 / 72
Staph. hyicus	2	15	19	7 / 19	19/19	19/ 19
Strept. suis+	2	4	8	7 / 7	-	7 / 7
E. coli.	3	-	6	-	6/6	6 / 6
*A. pyogenes**	1	2	4	2 / 2	-	2 / 2
Staph. aureus	-	1	1	1 / 1	-	1 / 1
Not yet identified	-	4	4	-	-	-
TOTAL	**32**	**50**	**114**	**89 / 101**	**25 / 25**	**107 / 107**

+ One isolate not yet susceptibility tested
* Two isolates not yet susceptibility tested

Case report: Tetracycline overdose in weaned pigs

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A piglet producer housing 730 sows and their offspring was unable to sell his weaners due to severe distortions of the limbs and joints of the fore and/or hind legs. Three affected pigs were sent to necropsy. Via various microbiological and molecular examinations detecting Haemophilus parasuis, Streptococcus suis, porcine Mycoplasma species, etc., no infectious agent could be identified. Moreover, an in-depth examination of the feed revealed no evidence of malnutrition. Further information being required, an on-farm investigation was performed. It was seen that suckling piglets as well as one to two week weaned piglets were unaffected. Older pigs however, displayed various stages of lameness, splaying of claws and distortions of joints and limbs of the fore and/or hind legs. The severity of the clinical manifestation increased with age and weight. Genetics, malnourishment and housing conditions could be ruled out as the main cause. Thorough questioning of the farmer revealed that the pigs had been receiving tetracycline for seven to eight weeks via the water supply because of a continuous respiratory infection. A recalculation exposed that instead of the animals receiving 40 mg / KG body weight, they had actually received up to 168 mg / KG body weight, which is four times the recommended dosage. This overdose was maintained by a misuse of the water medication system. Change of antimicrobial substance, as well as an appropriate use of the medication equipment was recommended. After 5 weeks, no further clinical symptoms were observed in piglets newly introduced in the nursery unit.

Development of a device for automatic detection of lameness in sows

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Lameness in sows is an important welfare concern as well as a cause of considerable economic loss. Early detection of lameness is required to prevent unnecessary distress of sows and to avoid huge financial losses due to medical costs and early culling. In general, lameness in sows is evaluated by visual scoring of the gait. However, visual assessment is a subjective technique with low reproducibility. The natural stilted locomotion of sows and their instinct to suppress clinical signs of lameness, make detection even more difficult. Considering the importance of lameness in sows, the need arises for more accurate and objective methods with a high sensitivity/specificity to enable an early and correct detection of the condition. Therefore, a detection system, based on force plate analysis and image processing, was developed. The construction, basically a transportable cage, is built in aluminum. After a sow entered, the box is closed and a static measurement is performed. The bottom of the cage contains load cells to analyze the force exerted by each of the four legs. By use of a camera and through calculating specific angles on the derived pictures the posture of the hind legs can be assessed. The idea behind this approach is that a lame sow will exert less force/weight on the lame limb and, to obtain this, will also adopt a different posture. Validation of the detection method is ongoing and the first results will be presented on the poster at the conference.

Application of the DIVA principle to Salmonella Typhimurium vaccines avoids interference with serosurveillance programmes in pigs

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Salmonellosis is one of the most important bacterial zoonotic diseases in humans and Salmonella infections are often linked with the consumption of contaminated pork. Salmonella enterica subspecies enterica serovar Typhimurium (Salmonella Typhimurium) is most frequently isolated from pigs and it is also the most prevalent serovar in humans. Vaccination has been proposed to control Salmonella infections in pigs. However, pigs vaccinated with the current vaccines cannot be serologically discriminated from infected animals. We therefore examined which LPS encoding genes of Salmonella Typhimurium can be deleted to allow differentiation of infected and vaccinated pigs, without affecting the vaccine strain's protective capacity. For this purpose, deletion mutants in Salmonella strain 112910a, used as vaccine strain, were constructed in the LPS encoding genes: rfbA, rfaL, rfaJ, rfaI, rfaG and rfaF. Inoculation of BALB/c mice with the parent strain, rfaL, rfbA or rfaJ strains but not the rfaG, rfaF or rfaI strains protected significantly against subsequent infection with the virulent Salmonella Typhimurium strain NCTC12023. Immunization of piglets with the rfaJ or rfaL mutants resulted in the induction of a serological response lacking detectable antibodies against LPS. This allowed a differentiation between sera from pigs immunized with the rfaJ or rfaL strains and sera from pigs infected with their isogenic wild type strain. In conclusion, applying deletions in the rfaJ or the rfaL gene in Salmonella Typhimurium strain 112910a allows differentiation of infected and vaccinated pigs in an LPS based ELISA without reducing the strain's protective capacities in mice.

Genome sequence of Helicobacter suis supports its role in gastric pathology

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Helicobacter suis has been associated with chronic gastritis, ulcers of the pars oesophagea and decreased daily weight gain in pigs, and with gastritis, peptic ulcer disease and mucosa-associated lymphoid tissue lymphoma in humans. In order to obtain better insights in the genes involved in pathogenesis, the genome of two H. suis strains isolated from the gastric mucosa of swine was analysed. This microorganism possesses genes allowing it to resist the very low pH of the gastric lumen and to move away from acid towards the gastric mucosa which has a neutral pH. H. suis also harbours several putative outer membrane proteins, of which two similar to the H. pylori adhesins HpaA and HorB which may play a role in adhesion to mucus and gastric epithelial cells. Genes encoding factors possibly involved in induction of lesions were also detected. These include the proinflammatory neutrophil-activating protein and y-glutamyl transpeptidase which causes necrosis of gastric epithelial cells. It was concluded that although genes coding for some important virulence factors in H. pylori, such as the cytotoxin-associated protein (CagA), are not detected in the H. suis genome, homologs of other genes associated with colonization and virulence of H. pylori and other bacteria are present.

Zero prevalence of salmonellosis in wild boars in Finland

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Studies of salmonellosis among wild boars in Europe report 10-50 % seroprevalence. In contrast to that, Finnish nationwide surveillance system reports under 1% salmonella prevalence in the pig . The aim of our study was to determine the prevalence of salmonellosis in farmed wild boars in Finland. Based on a national record of wild boar farmers, a sampling frame was compiled. Every farm on that list was contacted first by mail and the non-responders received a phone call from the research group. All volunteer farms were included. A faecal sample was obtained from all animals slaughtered in the study farms during 2005-2008. Salmonella spp. were detected with faecal culture (ISO 6579:2002, amd. 2007). Altogether 196 samples were collected from 28 different farms, an average of 6.8 samples (1-41) per farm. Individual samples were pooled in the laboratory before culturing. One pooled sample contained a faecal sample from 1-7 individual animals. In total, 51 pooled samples were cultured and they all proved to be negative. In conclusion, zero prevalence of salmonellosis in farmed wild boars is in accordance with the overall salmonella prevalence in the pig in Finland.

Clostridium perfringens type A associated piglet diarrhea in a sow herd: vaccination with a new alpha- and beta 2-Toxoid vaccine

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Aim of the study

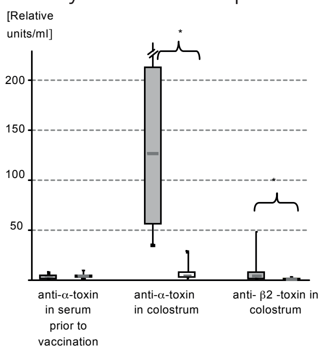
Clostridium perfringens type A (CPA) strains expressing a- and ß2-toxins are often involved causing diarrhea in sucking piglets. Vaccination of pregnant sows with herd specific CPA strains does not result in high antitoxic antibody levels. In this field trial in a sow herd with a high prevalence of piglet diarrhea (36%) and a constant detection of ß2-positive CPA strains in feces samples the preventive effect of a new commercial CPA vaccine (IDT Biologika) containing standardized amounts of both toxins was examined.

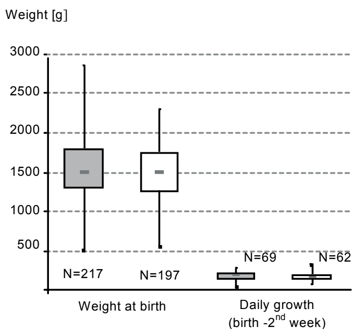
Materials and methods

After the identification of involved pathogens, 34 sows from one breeding group out of a herd with 300 sows were randomly distributed into the vaccine group (n=18) and the control group (n=16). Sows were vaccinated twice, in the 5th and in the 2nd week ante partum. Local and systemic reactions as well as piglet weights and the incidence of diarrhea were recorded within the two groups.

Results and discussion

In the vaccine group 217 piglets (21% diarrhea, 6.5% losses) and in the control group 197 piglets (25.4% diarrhea, 9.1% losses) were born. Temporary mild local but no systemic reactions occurred in vaccinated sows. Anti-toxin-titers were significantly increased in the colostrum of vaccinated sows and positively correlated with litter weights at day 4 post partum. Because of the high immunogenicity the CPA Toxoid vaccine will be an appropriate measure for the prevention of CPA associated piglet diarrhea. Nevertheless, the sow´s health status is decisive for the mostly multifactorial problem of piglet diarrhea.





The boxes represent the 50% between 25% and 75% quartiles. The line inside the box indicates the median. The top and bottom lines denote maximum and minimum values. Significant differences ($p<0.05$) are indicated by asterisks.
Vaccinated sows,
control group.

Isolation of Brachyspira spp. from pigs and rodents

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Aim

To detect all occurring variants of Brachyspira in pigs and rodents, two different isolation methods were used.

Materials and methods

Samples were taken from growers and fatteners and from rodents caught in pig houses. Two plates of solid selective media with different antibiotic concentrations were used; Medium I, ordinary medium for routine diagnostics of Brachyspira spp. and Medium II, developed for the isolation of the human spirochaete B. aalborgii with fewer and lower concentrations of antibiotics. One culturette was used for inoculation of both media. Medium II was always inoculated first and the plates were incubated for up to ten days in 42OC (Medium I) and up to three weeks in 37OC (Medium II).

Results

From 11 of 48 positive pig samples, and eight of 37 positive rodent samples, two or more phenotypes were recovered from one individual swab. For rodent and pig isolates all together, 64% (70/110) of the total amount of isolates were recovered from Medium I, and 50% (55/110) from Medium II. Using both media enhanced the outcome with 57% when adding Medium II and 100% when adding Medium I.

Discussion

Although a limited number of animals and farms studied, the results indicate a larger diversity of spirochaetes in individual pigs and rodents than previously presumed. The use of two different isolation methods increased the total output of unique rodent and porcine isolates by 57-100%. The conclusions are that for optimal recovery of Brachyspira spp. from pigs and rodents, different isolation methods should be used in parallel.

Correlation between quantitative faecal excretion of Lawsonia intracellularis and fecal dry matter in pigs without gross lesions of proliferative enteropathy

Ken Steen Pedersen[1], Marie Staahl [2], Øystein Angen[2], Roberto Guedes[3], Tim Jensen[2], Sven Erik Jorsal[2], Helle Stege[1], Jens Peter Nielsen[1], University of Copenhagen National Veterinary Institute, Technical University of Denmark Veterinary School, Universidade Federal de Minas Gerais

Introduction

The objective of the current study was to investigate association between the quantitative faecal excretion of Lawsonia intracellularis (LI) and faecal dry matter in pigs without gross lesions of proliferative enteropathy (PE).

Material & Methods

Data previously obtained from 5 herds with a high prevalence of LI (>75% of sampled pigs) in pigs with diarrhoea (1) was used.
In each herd the samples had been obtained by selecting a simple random sample of 8 pigs with and 8 pigs without diarrhoea during acute outbreaks of diarrhoea in weaners. All pigs were subjected to necropsy, faecal qPCR testing (2) and faecal dry matter (DM%) determination (3).
Association between the quantitative LI excretion (log10 LI cells/gram faeces) and faecal dry matter was investigated in LI positive pigs without gross PE lesions using a linear mixed model.

Results

A total of 53 LI positive pigs without lesions of PE were included in the analysis. An increase of 1 log10 LI cells/gram faces was associated with a 1.03 DM% decrease ($p=0.026$), figure 1.

Discussion & Conclusions

We observed a correlation between increasing LI excretion levels and decreasing DM%. This implies that LI may be the cause of diarrhoea even in pigs without gross lesions of PE. However, further conclusions awaits results of histological and further microbiological examinations.

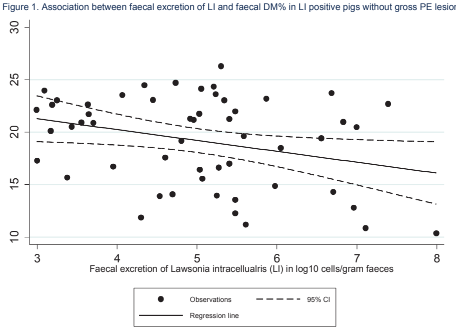

Figure 1. Association between faecal excretion of LI and faecal DM% in LI positive pigs without gross PE lesions

References

1. Pedersen, et al., Proc 2nd ESPHM: pp. 49-50.
2. Staahl, M. et al., Abstract, Advances in qPCR 2008.
3. Pedersen, et al., 2009. Proc 1st ESPHM: p. 67.

Clinical predictors of diarrhoea

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Introduction

Diarrhoea is an intermittent clinical sign. The objective was to identify permanent clinical predictor signs for identification of individual pigs with diarrhoea and estimation of diarrhoea prevalence.

Material and Methods

A cross sectional study was conducted in 20 herds in Denmark. During outbreaks of acute diarrhoea a systematic random sample of 80 pigs was subjected to a clinical examination. Faecal samples were obtained. Loose and watery consistency was considered diarrhoea (1). Potential clinical predictor signs of diarrhoea were examined in a predictive mixed model. For the most promising predictors a combined diagnostic sensitivity (SE) and specificity (SP) were calculated.

Results

A total of 1585 pigs were included in the analysis (range of with-in batch diarrhoea prevalence: 0.25 to 0.67). Peri-anal irritation and/or perineal faecal staining were identified as predictors of diarrhoea (SE = 0.19; SP = 0.98). Positive (PPV), negative (NPV) predictive values and apparent prevalence are displayed in figure 1 and 2.

Discussion

The PPV and NPV imply that false negatives are a larger problem than false positives. Relying exclusively on these clinical signs for identification of individual pigs for treatment of diarrhoea can not be recommended and they will underestimate the occurrence of diarrhoea when used on batches of pigs. The results in this study are only valid for diarrhoea prevalence between 0.25 and 0.67

References

1. Pedersen, K.S., Toft, N., 2011. Intra- and inter-observer agreement when using a descriptive classification scale for clinical assessment of faecal consistency in growing pigs. Preventive veterinary medicine, 98 p. 288-291.

Figure 1. Positive (PPV) and negative (NPV) predicitive values using peri-anal irritation and/or perineal faecal staining for identification of pigs with diarrhoea

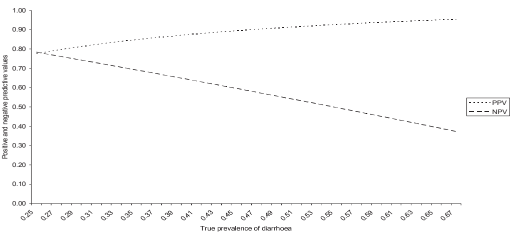
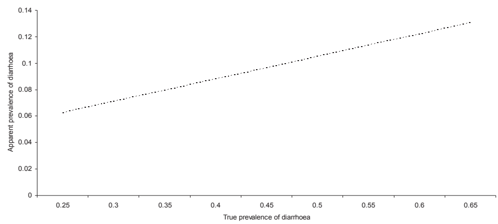


Figure 2. Association between true and apparent prevalence of diarrhoea using per-anal irritation and/or perineal faecal staining as clinical markers of diarrhoea



Estimation of diarrhoea prevalence using diarrhoeic faecal pools on the pen floor

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Introduction

The objective was to investigate association between the number of diarrhoeic faecal floor pools and diarrhoea prevalence in a batch of weaned pigs.

Material and Methods

Diarrhoeic faecal pools on the floor of the pens were counted during outbreaks of acute diarrhoea in pigs 10-70 days post-weaning. A systematic random sample of 80 pigs was subjected to faecal consistency examination. Loose and watery faecal consistency was considered diarrhoea (1). All examinations were performed at the same time of the day. The association between the number of diarrhoeic floor pools and diarrhoea prevalence in a batch was analysed by linear regression analysis. In the analysis the number of diarrhoeic pools was standardized to a room containing 300 pigs.

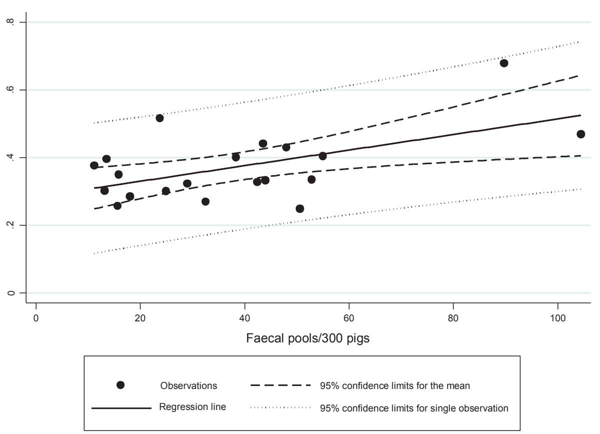
Results

One outbreak in each of 20 herds was investigated. The with-in batch diarrhoea prevalence ranged from 0.25 to 0.67. A linear relationship between the number of diarrhoeic floor pools and diarrhoea prevalence was demonstrated (p=0.01), figure 1.

Discussion

The observed correlation between diarrhoeic floor pools and diarrhoea prevalence in a batch of pigs was expected. However, estimation of diarrhoea prevalence using diarrhoeic floor pools should be applied with caution since 95% confidence limits were wide. Further, the reported linear association was highly influenced by the two largest numbers of diarrhoeic pools. Removing these values resulted in a non significant linear association.

Figure 1. Association between the number of diarrhoeic faecal floor pools and diarrhoea prevalence in a batch of weaned pigs



References

1. Pedersen, K.S., Toft, N., 2011. Intra- and inter-observer agreement when using a descriptiv classification scale for clinical assessment of faecal consistency i growing pigs. Preventive veterinary medicine, 98 p. 288-291.

Diurnal variation of diarrhoeic faecal pools on weaner pig pen floors

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Introduction

The objective was to investigate the diurnal variation in the number of diarrhoeic pools on the floor of pens containing weaned pigs.

Material and Methods

In each of two herds, 30 pens were selected at convenience. Diarrhoeic faecal pools on the floor of each pen were counted at time points 8am, 9am, 11am, 12pm and 15pm during one day. Loose and watery faecal consistency was considered diarrhoea.

Results

In herd number one a U-shaped occurrence in the total number of faecal pools were observed, figure 1. Eleven pens showed a more or less U-shaped number of diarrhoeic pools, figure 2, while the remaining pens showed various trends. In herd number two the overall number of diarrhoeic pools was equal at time points 8am, 11am and 12pm. Compared to 8am the number had increased by 32% at 9am and decreased by 22% at 15pm.

Discussion

Prevalence of faecal pools at the pen floor is widely used to for decision making regarding antibiotic treatment of diarrhoea in pig herds. The current small scale study demonstrates that a pronounced with-in day variation in number of faecal pools exists at the pen level. The U-shaped occurrence in herd number two implies that the variation can not be explained by outbreak initiation or termination only.
In conclusion: The time point of faecal pool observations may influence the clinical picture of diarrhoea on the batch level and thereby decisions on treatment strategy.

Figure 1. Mean number per pen of diarrhoeic pools on the pen floor during one day (herd 1, n=30 pens)

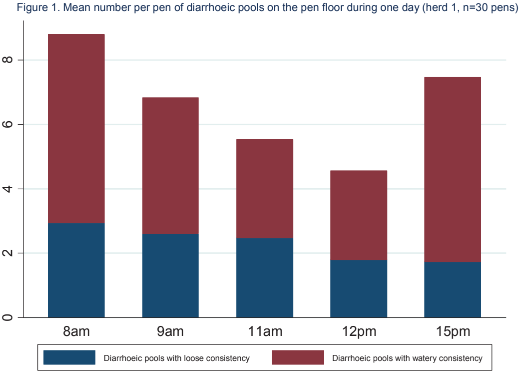
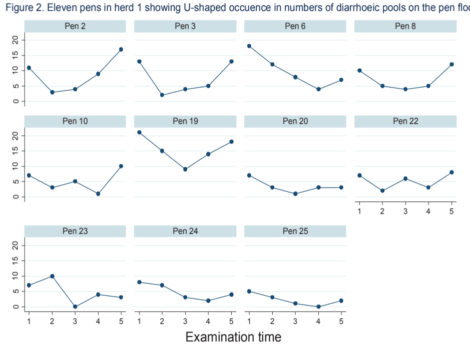


Figure 2. Eleven pens in herd 1 showing U-shaped occuence in numbers of diarrhoeic pools on the pen floor



X-axis: 1=8am, 2=9am, 3=11am, 4=12pm, 5=15pm

Comparative investigations about the occurrence of Salmonella spp., Yersinia spp. and Campylobacter spp. in fattening pigs and their carcasses

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Introduction

The health status of fattening pigs concerning Salmonella, Yersinia and Campylobacter spp. was compared to the status of their carcasses. The aim of this study was to determine the most suitable time to have a correlation between the results of farm sampling and examinations at slaughter.

Material and Methods

545 pigs from 10 farms were examined serologically for Salmonella and Yersinia (ELISA) and by faecal swabs for Campylobacter spp. (PCR) at the middle and the end of fattening. At slaughter, meat juice samples were examined for Salmonella and Yersinia (ELISA) and swabs from the carcass surface for Campylobacter spp. (PCR).

Results

With 0.8% (≥40 OD%) the proportion of Salmonella positive animals was low. Using a cut-off ≥20 OD%, a tenfold increase was observed.
At the end of fattening 56.1% of animals were Yersinia spp. positive in comparison to 60.0% at slaughter. Campylobacter spp. was detected by PCR in 100% of the faecal swabs, but various detection rates (5.1% - 64.2%) appeared in surface swabs according to abattoir.

Discussion

Due to low detection rates of Salmonella spp. with current European Swine-Salmonella cut-off ≥40 OD%, a reduction of cut-off up to ≥20 OD% could be suitable to detect infected farms. The high prevalence of Yersinia spp., indicates serological examination as a practicable tool for farm screening. The occurrence of Campylobacter spp. is improperly for farm screening but a suitable indicator for a faecal cross-contamination at abattoir. Present results indicate, that the most suitable timeframe for a farm screening is within 14 days prior to slaughter.

Palatability problems with zinc oxide and zinc sulphate as diarrhea treatments.

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Therapeutic doses of in-feed ZnO (3000ppm) have become a common practice in some EU countries to prevent or treat diarrhea in weaning pigs. However, high doses Zn are not retained by the animals, provoking a high Zn excretion in the slurry and environmental concerns. Alternative more soluble sources of Zn, such as Zn sulphate (ZnSO4), may allow for a likely reduction of in-feed Zn doses. However, the presence of soluble Zn in the mouth may provoke palatability problems and feed refusal. In the present trial we evaluated the palatability of a range dose of ZnO and ZnSO4 in feed by double-choice feeding trials. Two-hundred and forty 28 days old piglets were weaned and allocated by sex and weight in twelve pens (20 pigs / pen). Pens were initially distributed to six different treatments at random: 1000, 2000 and 3000 ppm of ZnO or 300, 600 and 900 ppm of ZnSO4, and rotated in three periods following a crossover design for each Zn source. The six treatments were compared with a control diet without added zinc. Both, ZnO and ZnSO4 showed a lower preference than the control diet at doses of 3000ppm for ZnO (25.09% of the total intake, p-value=0.0005) and 600 ppm and 900 ppm for ZnSO4 (32.83% and 27.07%, p-values=0.0259 and 0.0261, respectively). On a fourth period 3000 ppm of ZnO was compared vs 900 ppm of ZnSO4 in all pens. Animals fed previously on ZnSO4 showed a preference for the ZnSO4 (62%), animals fed on ZnO did not show any preference.

In vitro comparison of carvacrol, formic acid, and zinc oxide effects on hindgut fermentation of pigs fed four different diets

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The ban of antibiotic growth promoters (AGP) in the EU intensified the search for alternatives in the last decade. So far, ZnO and acidifiers are the most successful alternatives. Other additives as plants extract have shown promising results but more studies are needed to optimize its use. Some studies have shown already the importance of different ingredients on the effects of plant extracts on hindgut fermentation and growth of bacteria. This in vitro study compared the effects of carvacrol (100 and 1000ppm) to those of formic acid (1.5%) and zinc oxide (3000ppm) on hindgut fermentation using intestinal contents from pigs fed 4 different diets with different fiber sources; standard corn (SC), coarse ground corn (CGC), sugar beet pulp (SBP) and wheat bran (WB). Gas produced by fermentation and growth of coliform bacteria, enterobacteria, clostridium, total aerobic bacteria, and lactobacilli on cecal contents were measured.
Carvacrol at 1000ppm totally and formic acid partially inhibited gas production in the 4 diets studied. Carvacrol decreased growth of clostridium, total aerobic bacteria and lactobacilli but formic acid affected only clostridium. These differences on bacterial growth inhibition could be related to the different levels of gas production inhibition. The diet containing SBP and the treatment with ZnO showed a different gas production kinetic over time than all other treatments and diets. Both showed a delay in gas production and showed a higher total gas production. Carvacrol at doses normally used (100ppm) showed no effects on hindgut fermentation.

Improves performance in toltrazuril treated pigs by vaccination against ileitis

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Introduction
Lawsonia intracellularis (LI) causes ileitis and is highly prevalent in modern pig production. Treatment with tultrazuril is claimed to make pigs less sensible to LI (1). This study examined the effect of LI infection on the performance of tultrazuril treated pigs by comparison of non-vaccinates and pigs vaccinated against ileitis.

Material & Methods
The herd was a Danish SPF herd weaning 1000 pigs every week. All piglets were treated with toltrazuril, but antibiotics were used only when disease was observed. The study included 16 batches of pigs; every second batch vaccinated with Enterisol® Ileitis (2 ml/pig administered at 31 days of age in drinking water just before the pigs were weaned).
For comparison of vaccinates and non-vaccinates, group treatments with antibiotics and carcase weight was recorded, and average daily gain (ADG) and number days to slaughter was calculated on the individual pig level. Statistical comparison used Students t-test, Kolmogorov-Smirnoffs test or chi-square test with p= 0.05 as level of significance.

Fig. 1: Administration of vaccine via proportioner. Left: Addition of vaccine solution to drinking water. Right: Pig drinking the vaccine solution from a drinking nipple.

Results
In the nursery, group treatments were given against weaning diarrhoea and ileitis (table 1). In finishers, only one batch (vaccinated) received treatment (Tilmicosin, respiratory disease). Slaughterdata were obtained from the last 10 batches and showed significantly higher carcase weight, fewer days to slaughter and higher ADWG in vaccinates (fig. 2).

Product	No vaccine	Enterisol® Ileitis	p-value
# batches	7756	7900	-
# pigs treated for weaning diarrhoea[a]	3734	3274	<0.001*
# pigs treated for ileitis[b]	2845	520	<0.001*

Table 1: Number of nursery pigs treated with antibiotics in batches of non-vaccinated pigs compared to pigs vaccinated against ileitis

a: Diarrhoea in the first 3 weeks after weaning, treated with either sulfa/TMP or aminoglycoside.
b: Diarrhoea more than 3 weeks after weaning, treated with oxytetracycline.
* = Significant difference between number of pigs treated in vaccinated and non-vaccinated batches.

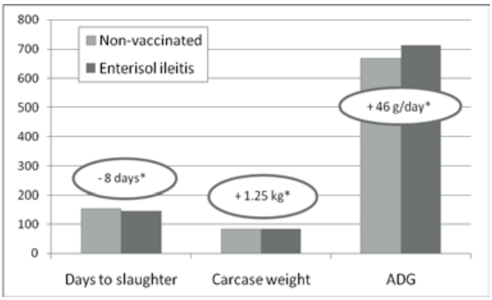

Fig. 2: Production figures from weaning to slaughter for pigs treated with toltrazuril. Illustration of the effect of vaccination against ileitis. Based on slaughterhouse data from 5 batches vaccinated against ileitis (2083 pigs) and 5 non-vaccinated batches (1388 pigs).
* = Significant difference between result in vaccinated and non-vaccinated batches.

Discussion & Conclusions

Despite treatment with toltrazuril, performance of pigs until slaughter was significantly impaired by infection with LI, shown by improved performance in pigs vaccinated against ileitis.

References

1. McOrist et al.(2010): The pig Jounal 63, 73-79.

Tail biting alters feeding behavior of victim pigs

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Tail biting is painful to the victim pigs and impairs daily weight gain. However, little is known about the effect of pain on the feeding behaviour of victim pigs. Therefore, we studied computerized feeder data from 13 tail-bitten pigs weighing 30 – 90 kilograms in 7 pens from 5 days before to 5 days after the bite wound was first noticed at day 0. Pigs with fresh bite wounds were selected from a finishing herd with one automatic one-space feeder per group of 11 pigs.
We calculated daily duration at feeder, mean daily intervals between feeder visits and mean daily feeding efficiency (feed consumed in grams divided by time spent at feeder in seconds). The differences between observed days were compared with repeated measures mixed models.
The time spent in feeder, feeding efficiency and feeder visit intervals differ significantly between days ($p<0.001$ for all). The duration in feeder decreased from day -1 to day 0 and increased again until day 2 ($p<0.05$). Feeding interval increased from day 0 to on day 2 ($p<0.05$) and feeding efficiency elevated significantly during days -1 and 2 ($p<0.05$).
Tail-biting altered feeding behaviour of victims in a single-space feeder system, where the victim's tail is exposed to other pigs' manipulation while feeding. Observed change in feeding efficiency from day -1 indicates the difficulty in detecting tail-biting damage and behavioural changes being more sensitive. We suggest that these feeding pattern changes at the onset of tail-biting might be due to pain experienced by the victim pigs.

Effect of tail presence on the welfare status of italian heavy pigs

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Directive 2008/120/CE prohibits tail-docking as a routine intervention in pigs, due to the cruelty of the action and the possible development of painful neuromas. In Italy, producers might not routinely apply this provision due to the pig aggressive behaviour that can trigger tail biting. This work aims at evaluating the welfare implications and the management feasibility of avoiding tail-docking within the Italian heavy pig production system, on which no scientific literature is available.
The study involved 672 commercial hybrid pigs (sex ratio and docked/undocked ratio 1:1). From 80 to 290 days of age, pigs were reared in a fattening farms

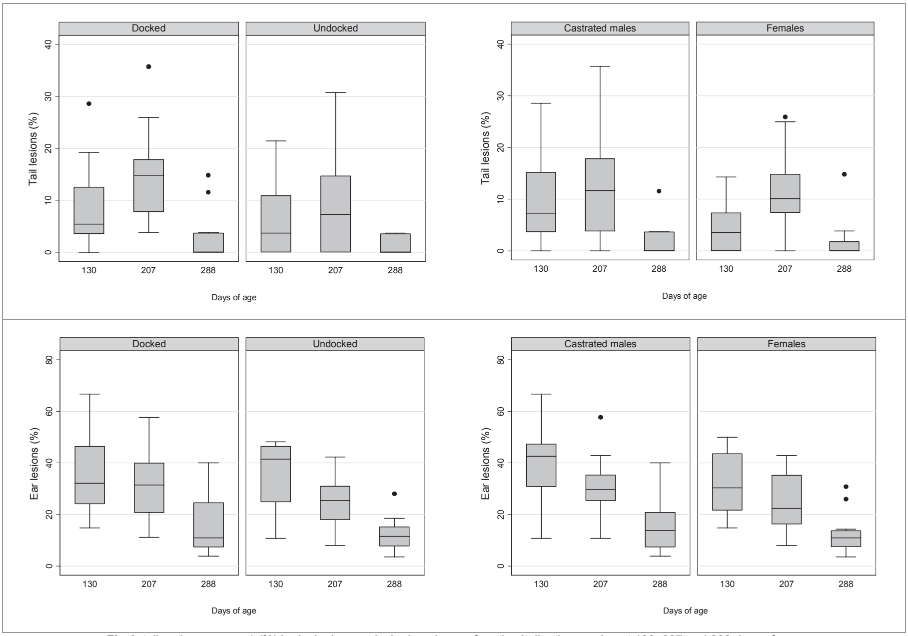

Fig.1: tail and ear scores 1 (%) in docked *vs.* undocked, males *vs.* females Italian heavy pigs at 130, 207 and 288 days of age.

equally distributed in 24 pens (males and females were not mixed). Serum haptoglobin (Hp), A/G ratio and cortisol concentrations were determined on 6 randomly selected pigs per pen at 122, 210 and 274 days of age. In all the 672 animals tail and ear lesions were scored (from 0 to 2) at 130, 207 e 288 days.
Each pen, whose dry matter intake was daily recorded, was weighted at 81, 130, 207 and 288 days. At 274 days of age females presented higher values of Hp than males ($P<0.001$). No significant differences among the groups were detected for skin scores 1 (fig.1); tail lesions were more frequently identified at 210 days, whereas ear lesions progressively decreased. Score 2 for tail lesions (undocked only) was 0% at 130, 1.2% at 210 and 0% at 274 days. No significant differences among groups were observed for live weights and gain to feed ratios.

Tail and ear biting in undocked Italian heavy pigs during fattening period

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In the prolonged fattening cycle of Italian heavy pig, tail docking is still performed even if it is forbidden by legislation due to the tail biting observed in undocked pigs. Occurrence of this behaviour could be also increased by the absence of adequate environmental enrichments, such as straw. Aim of the study was to evaluate the feasibility of fattening undocked pigs under the specific Italian farming conditions, considering the effect of the presence of straw as environmental enrichment.
The study was carried out according to a factorial design 2x2 to test the effects of presence of tail and availability of straw in a rack. The study lasted 30 weeks and adopted 672 pigs housed in 24 pens of 28 pigs each. To monitor the development of tail and ear biting, direct observations (behavior sampling) were carried out at 3, 9, 18, 29 wks of fattening for 4 h/each. The risk factor analysis (table 1) showed that the risk of tail and ear biting increased when straw was not available whereas in docked pigs is was lower for both tail and ear biting. Regardless of the presence of tail and straw the risk of observing tail and ear biting decreased over time. The presence of tail could be a risk factor for tail and ear biting, however the provision of straw seems to prevent these behaviours even if the fattening cycle is prolonged as in the case of heavy pigs, allowing to rear undocked pigs.

Table 1. Risk factors analysis on tail and ear biting during fattening in heavy pigs.

	Risk factor	Levels	Odds ratio	95% confidence interval	*P*
Tail biting	Straw[1]	No vs. Yes	2.50	1.83 – 3.42	<0.001
	Tail[2]	Docked vs. Undocked	0.35	0.25 – 0.48	<0.001
		3 vs. 29	17.17	7.54 – 39.89	<0.001
	Week of fattening	9 vs. 29	9.69	4.18 – 22.46	<0.001
		18 vs. 29	3.33	1.34 – 8.28	0.01
Ear biting	Straw[1]	No vs. Yes	1.52	1.37 – 1.69	<0.001
	Tail[2]	Docked vs. Undocked	0.80	0.72 – 0.88	<0.001
		3 vs. 29	16.98	12.34 – 23.35	<0.001
	Week of fattening	9 vs. 29	12.98	9.41 – 17.91	<0.001
		18 vs. 29	4.40	3.12 – 6.21	<0.001

[1]No = absence of straw as environmental enrichment; Yes = straw always available in a metal rack.
[2]Docked = pigs submitted to tail docking in the first week of life; Undocked = pigs not submitted to tail docking.

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