

Approaches to reduce antibiotic resistance in the pork supply chain.

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Abstract

Occasionally, use of antibiotics is necessary to treat diseased animals. Prudent use is however necessary, as antibiotic usage can evoke the selection and propagation of antibiotic resistant bacteria. Antibiotic resistance in pigs is primarily a occupational risk for those who are in contact with pigs. Secondly, contamination of the environment and fresh food may expose the general population to resistant bacteria. Strict hygiene at slaughter (including a zero tolerance on fecal contamination) can prevent the contamination of food with resistant bacteria.

Recent experience in The Netherlands shows that obligatory reporting of antibiotic usage and accompanying benchmarking, can result in a marked reduction. Also a ban on use of critical antibiotics (fluoroquinolones and cephalosporins) appeared to be feasible. We hypothesize that good animal health and optimal biosecurity are crucial to further reduce the occurrence and propagation of antibiotic resistance. To support the farmers, veterinarians, and other advisors in these areas, we assumed that the collection of data on health parameters in the slaughterhouse has an added value. Pathological findings is “classical” information about the health of the slaughtered animals. It was studied whether serological results from blood collected in the slaughterhouse, can be complementary information

We show that differences in Salmonella-, Mycobacterium avium- and Toxoplasma- status can be used as a derivative of internal and external biosecurity at the farm. Serology on slaughterhouse blood for pathogens of the lung disease complex (e.g. PRRSV and *Mycoplasma hyopneumoniae*) provides additional information, which can support the animal health management.

It is concluded that future challenges lay in exchange of easily accessible information collected in slaughterhouses, development of management alternatives based on this information, and development of additional serological methods.

Introduction

Antibiotics have influenced the therapeutic possibilities in human and veterinary medicine drastically after their discovery in the 1940s. Occasionally, use of antibiotics is necessary to treat diseased animals. In animal populations where the transmission of infection is very likely, it can also be used to mitigate the severity of disease in not yet clinically ill animals. The question is however in which situations this is good veterinary practice. Prudent use is necessary, as antibiotic usage can evoke the selection and propagation of antibiotic resistant (ABR) bacteria.

Antibiotic resistance in pigs is primarily a occupational risk for those who are in contact with pigs. This is for example seen in LA-MRSA, where those people who are in contact with live pigs are most likely to be colonized (GILBERT, 2012), however the pathogenicity of LA-MRSA is questioned (HEALTH COUNCIL NL, 2011). Secondary spread of ABR bacteria may contaminate the environment and fresh foods, and may therewith expose the general population to resistant bacteria.

Which sources finally attribute most to human exposure (environment-to-human, human-to-human, animal-to-human, or food-to-human) is marginally known. Moreover, the presence of resistant bacteria in live animals does not necessarily mean that this will lead to contamination of meat, and afterwards consumers. Strict hygiene at slaughter can prevent the contamination of pork with Salmonella (VAN HOEK, 2012) and accordingly with resistant bacteria that are present in the intestinal tract of pigs.

Independent of the actual size of the contribution of antibiotic usage in animal production on the antibiotic resistance in men, there is societal and political pressure to reduce antibiotic usage in the animal production chains. Therefore the animal supply chain should prudently use antibiotic, and try to reduce the number of treatments and refrain from critical antibiotics.

Recent experience in The Netherlands shows that obligatory reporting of antibiotic usage and accompanying benchmarking, resulted in a quick reduction of its usage (MEVIUS, 2012). Also a ban on use of critical antibiotics (fluoroquinolones and third and fourth generation cephalosporins) was implemented.

We hypothesize that good animal health and optimal biosecurity are crucial to reduce the occurrence and propagation of antibiotic resistant microorganisms. When animals are healthy, there is no need to treat them with antibiotics. And when antibiotic resistance occurs, and good hygienic barriers are present, further transmission of resistant micro-organisms will be prevented. One of the building blocks that was investigated is the idea that the information generated from collection of data in the slaughterhouse has an added value to support farmers, veterinarians, and other advisors in these areas. Pathological findings is “classical” form of data collected at the slaughterhouse that contains information about the health of the slaughtered animals. It was studied whether serological results from blood collected in the slaughterhouse, contains complementary information for this purpose.

First serological data may be used as generic hygiene/biosecurity parameter. For this purpose serological data that is collected for other purposes may be used. In many countries serology in slaughterhouses (either on meat juice or on serum) is collected for Salmonella serology. To control Salmonella the herd status of pig herds is assessed by serology in several countries, like Denmark, Germany and The Netherlands. Recently, other serological analyses were added to this slaughterhouse serological screening. In risk based meat inspection systems Mycobacterium avium- and Toxoplasma- serology are used to verify the hygiene status of the farm supplying to the slaughterhouse. Mycobacterium avium serology is performed to eliminate the need of incising the lymph nodes during meat inspection (HILLER, 2012). Toxoplasma is assessed as this is a relevant zoonotic agent, ingested with raw meat from pigs and cattle too (JONES, 2009, OPSTEEGH, 2012). We assessed whether serology for these zoonoses provides additional information about the level of biosecurity control.

The use of serology on slaughterhouse blood can be extended. An important reason for usage of antibiotics in pig production are lung diseases. Other reasons are intestinal problems and streptococcal infections around weaning. The major lung pathogens in today's pig husbandry are Mycoplasma hyopneumoniae (Mhyo), Actinobacillus pleuropneumoniae serotype 2 (APP 2), swine influenza virus (SIV), porcine reproductive and respiratory syndrome virus (PRRSV), and porcine circovirus type 2 (PCV2). We therefore assumed that serology for pathogens of the porcine respiratory disease complex (PRDC) provides additional information, which can support the animal health management.

Material and Methods

Based on literature we made an assessment on the linkage between serology for Salmonella, Mycobacterium avium and Toxoplasma for biosecurity verification.

Secondly, the potential of slaughterhouse blood as predictor of pig herd health status, as reflected in technical performance of the herd and the usage of antimicrobial drugs, was explored. Twenty pig herds located in Southeast Bavaria were included in a study and followed during 4 fattening rounds. Blood samples at slaughter were randomly collected from a random delivery per round and submitted for ELISA serology. The blood was tested for antibodies of Mhyo, APP 2, SIV, PRRSV, and PCV2. Data on growth, feed usage and antibiotic usage were collected per farm. Statistical analyses were done to quantify the relation between serological response and technical performance (growth and feed efficiency) and antibiotic usage (for more details see: DÜSSELDORF, 2013).

Results

For the spread of Salmonella in pig herds biosecurity is of significant importance (BERENDS, 1999). From our assessment of the infection routes of Salmonella can be distinguished in external and internal routes; externally with piglet or gilts, rodents, birds etc. and internal transmission – from department to department by mixing pigs or carried by working personal, and failing cleaning and disinfection. Where biosecurity is well implemented, transmission of Salmonella will be prevented and less Salmonella positive serology will be found. *Mycobacterium avium* can be introduced by birds and contaminated water. Toxoplasma can be introduced by rodents or cats. Therefore positive serology may indicate that these introductory routes are

not in control. Pathogens that cause disease may use the same introductory or transmission routes, and ABR bacteria may use them as well.

Preliminary analyses showed that meaningful differences were found in serological statuses between the herds for the different lung pathogens. Analyses indicated that PRRSV was the most influential pathogen affecting technical herd performance. APP2, PCV2 and SIV significantly influenced the presence of pneumonia in pig herds, and APP2 was relevant to increasing clinical PRDC symptoms. The percentage of positive samples for the 5 parameters varied between zero and 85%. The proportion of positive samples was highly correlated with the percentage of pigs with symptoms of PRDC, the percentage of pneumonia per herd, the average daily growth rate (ADGR), and the average feed conversion rate (AFCR). (DÜSSELDORF, 2013).

Discussion

The assessment that was made indicates that the serology for zoonotic pathogens like Salmonella, MAA and Toxoplasma may predict the level of biosecurity. Without additional costs the serological results can be used to assess the biosecurity status and compare farms in a bench mark. .

The high correlation between the serological results for the lung pathogens and the herd technical performance indicates that the analysis of blood sampled at slaughter may aid in making better decisions on pig herd health management. Monitoring the five pathogens from the PRDC may enable an improvement in pig herd health, an increase in technical performance, and the promotion of the reduction of the usage of antibiotics in pig herds. Positive results have been reported for programs where blood is collected with regular intervals for serology on pathogens of the PRDC (e.g. Respig®, see: GEURTS, 2011). As the correlations with performance and positive serology at blood collected in the slaughterhouse are so good, the blood collection of these kind of strategies may as well be done in the slaughterhouse, were blood sampling can be done much easier and with less stress for the animal.

The promising thing in the serology in slaughterhouse blood is that results indicate that farmers who can improve their farm health will most likely improve their performance, and therewith increase their profitability. This may be an incentive for farmers to request for serology on slaughterhouse blood.

The serological screening is only an assessment. The information is getting value when the farmers, veterinarians and other advisors that have a professional role in advising the farmer use this information appropriately. Research is planned how farmers can use these data to set goal for further improvement of herd health and reduction of antibiotic usage.

Serological monitoring will only be a part of the solution. The serological tools described are the most easily available. For intestinal diseases additional tools have to be investigated.

Conclusion

It is concluded that future opportunities lay in exchange of easily accessible information collected in slaughterhouses, development of management alternatives based on this information, and development and application of additional serological methods.

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