THE ROLE OF ANIMAL HYGIENE AND HEALTH MANAGEMENT IN PIG PRODUCTION

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Introduction

The word "hygiene" (etym: from Greek: "hugiainein" or "hugieinon" = to express good health and welfare) refers to this part of medicine dealing with the environment where human beings are due to live and to the way of manipulating it so as to maintain health and welfare (Larousse dictionary, 1972). In veterinary medicine, it embraces the rules and practices aimed at maintaining animal health and welfare. Those aspects of biosecurity in particular those regarding human health protection and environmental preservation in relation to animal keeping are also included. Applied microbiology and applied epidemiology are two major scientific pillars of animal hygiene whereas prevention through an integrated approach is the key objective (Ekesbo 1988). Hence this is far broader than the common current acceptation of the word hygiene in the general public. The latter uses to restrict the sense of the word to designate cleanliness or decontamination.

Needless to mention the role of animal hygiene in pig production. The point is of particular importance in so-called multifactorial diseases or syndromes where the environment enveloping the pig is making the decision whether or not a given potential pathogen induces serious damages. On the other hand the pathogens must be kept outside the herds as far as possible. Therefore this paper will consider biosecurity. Then enzootic diseases the pig is familiar with in our confined intensive systems will be focused on.

Biosecurity in pig production

1. Introduction

In contemporary technical language, biosecurity relates to the control of the factors involved in the transmission of pathogens. This issue is becoming increasingly important in a market that is becoming increasingly international. The recent outbreaks of Foot and Mouth Disease (FMD) as well as those of Classical Swine Fever (CSF) in EU countries over the last few years have shown that nothing is certain with regard to freedom from epizootics. A real awareness regarding biosecurity is obviously needed, but still keeps us waiting. Biosecurity is not only essential in a situation of crisis involving notifiable diseases, but the underlying rules should also be considered with respect to all major diseases and routinely applied as part of normal herd health care. In this respect, the different partners of the industry and, furthermore, every citizen must know about biosecurity and be sufficiently responsible with regard to it. The world Animal Health Organisation (OIE) has been working hard to assess risks of disease transmission through international trade (OIE 1999). The code Commission of this organisation establishes an updated set of rules and also considers the practical aspects of their implementation (reliable diagnostic tests, quarantine management…)

According to Amass and Clark (1999) the broad meaning of biosecurity is "the literal safety of live things, or the freedom from concern for sickness or disease". In their review, the latter authors outlined that biosecurity is a continuous everyday challenge. In this paper, some of the main points which are related to biosecurity, as it is commonly and academically defined (Blood and Studdert 1999) will be displayed.

2. The living pig is potentially the major carrier of pathogens.

The status of the farm of origin regarding infectious diseases can easily be assessed for most of the pathogens as far as reliable laboratory tests are now available. Combining specific pathogen detection to broader health indicators (like lesions at slaughter ...) is a useful way to health assessment. Trading could be impaired because of unwanted infections. However ignoring health concerns when the pigs are moved is the worst option regarding health maintenance. The integrated farrow-to-finish system is undoubtedly the most secure system. When purchasing pigs, a farmer takes "*ipso facto*" the risk of introducing pathogens into his herd. In any case, loading pigs from a single source appears less risky than from a multiple source.

3. Airborne spread of pathogens, farm location

Airborne transmission of pathogens is difficult to properly assess because of too many uncontrollable variables. However, experimentations in totally controlled facilities have clearly shown airborne transmission of several pathogens over short distances. Actinobacillus *pleuropneumoniae* and PRRS virus were transmitted by air over a distance of 1 to 3 m. The relevance of these works is related to on-site biosecurity, since microbial airborne transmission may occur between adjacent rooms or compartments.

Most of the pathogens have been experimentally shown to survive in aerosols but their ability to infect declines over time. The effect of air temperature and humidity has been tested. Pseudorabies virus survived longer in low humidity (Schoenbaum et al 1990). Swine influenza virus was found to survive 15 hours at 21°C (Mitchell and Morin 1972). Several papers have reported on airborne spreading of diseases. Foot and Mouth Disease has been particularly studied in this respect in the UK and the virus was supposed to be transported over a long distance. Observations about the spread of pseudorabies in the UK, in Denmark and in the US also concluded to the evidence of long distance of airborne transmission of the virus. The role of Livestock density was deeply investigated in an EU research project where the focus was placed on prevention strategies (Huirne and Windhorst 2003).

4. Reproduction biotechnologies and risk of disease transmission

New reproductive technologies like Artificial Insemination (AI) do not require the breeders to be moved on farms, hence reducing the risk of disease transmission. The relationships between modern means of exchanging germplasm (Semen and embryos) and risk of disease transmission were recently investigated (Glossop and Cameron 2002). Special attention has to be paid to artificial insemination since from a single infectious source large numbers of farms located through out the world may become infected within a short period of time. For that reason, sets of regulations have been established in different countries or groups of countries, like those of the EU. On its side "the International Animal Health Code" of OIE gives practical recommendations regarding semen and embryos (OIE 1999). In any case, specific requirements are needed for the health status of the donors.

5. The feed and drinking water

Raw material for feed originates from multiple sources disseminated around the world. The potential of spreading pathogens in this way is considerable, though still debated. Due to its zoonotic trait, *Salmonella* in particular has been particularly studied. When feedstuffs are checked for *Salmonella*, positive results are obtained (Harris et al 1997). Unfortunately, the major isolates from the feed cannot easily be traced downstream in the digestive tract of the pigs and further investigations, including those regarding the sampling and pathogen detection procedures, are needed. Although on shorter distances, drinking water could also be a vector for undesirable pathogens.

6. Living vectors (other than the pig)

The role of people as mechanical vectors for pathogens has been suspected for several decades. But only recently has the question been seriously addressed (Amass et al 2000). It was revealed that, provided the main rules are respected, people are unlikely to be involved in disease transmission. The basic rules moving from one farm to the next are the following:

- Washing the hands when leaving and entering
- Use clean clothes assigned (belonging) to each farm *i.e.* at least boots, appropriate overalls, caps, gloves
- Wear a dust mask
- Use material assigned (belonging) to each farm (or after being cleaned and sterilised).

- Additional measures are welcome especially in case of acute outbreaks (free from exposure to pigs for 48 hours, shower …).

Many other living creatures can be vectors of pathogens. Regarding spreading of diseases on long distances, birds have the greatest potential. They were suspected about swine influenza virus (Pensaert et al 1981).

Over shorter distances, rodents and flies might also intervene. Streptococcus suis and PRRS virus were isolated from houseflies. In our institute, an investigation about rodents showed a variety of pathogens in mice and rats trapped of farms: Salmonella, Bordetella and rotavirus. Other studies demonstrated the carriage of Brachyspira hyodysenteriae, Leptospira, Encephalomyocarditis virus, and other infectious agents. Efficient rodent extermination measures are certainly to be encouraged. Finally, other animals might come in touch with pigs and an efficient fence around the premises is wise. In the late nineties in France, sporadic cases of Brucellosis were diagnosed in pig farms. All of them were outdoor operations, and a link to wild animals (wild boar) was suspected.

Role of animal hygiene in enzootic pneumopaties in growing-finishing pigs

The most common and economically detrimental diseases encountered in pigs in the EU are described as enzootic since they predominantly develop within those pig units where the required conditions exist. Among them, respiratory diseases have shown a broad range of severity depending on the conditions on the farm and other external influences (*e.g.*: season etc …. In this group can be mentioned bacterial diseases like atrophic rhinitis, enzootic pneumonia and pleuropneumonia. The term “enzootic” is schematically opposed to “epizootic” where typically, the diseases spread rapidly throughout the country and approximately demonstrate the same pattern in all the farms. Two viral diseases, swine influenza and PRRS, occur in this group although they also often evolve in an enzootic form. As a result, especially in densely populated pig areas they greatly enhance the above-cited disorders. The acronym PRDC[1] was used in the US to describe the respiratory syndromes in growing-finishing pigs. When pigs raised outdoors with large space allowance and a hut were compared to pigs raised on fully slatted floors (0.23 m²/pig at around 8-10 weeks of age), no significant difference could be found in lung lesions (Jolie et al 1997). On the other hand, in a French study (Lebret et al 2004), when pigs kept on fully slatted floors with 0.65 m²/pig were compared with pigs raised in an alternative system with sawdust-shave bedding (1.3 m²/pig) and a free access to an outdoor area (concrete floor with 1.1 m²/pig), the latter animals

[1] PRDC: Porcine Respiratory Disease Complex

exhibited lower scores regarding respiratory tract damages at slaughter. In an investigation in the USA (Straw et al 1991) pigs of around 30 kg live weight were either housed in an improved environment (Experimental facilities: partially slatted floor, 5 pigs/pen, 1.1 m^2/pig, high hygiene standard and good air quality, 50 pigs in common air space) or remained at their home farm (partially slatted floor with 2/3 solid, 25 pigs/pen, 0.48 m^2 and later 0.60 m^2/pig, 650 pigs in common air space). Home farm pigs had more pneumonia lesions at slaughter at the end of the trial. In this study like in the previous ones, the benefit in terms of health could not be attributed to a single variable but to the profile combining all the conditions.

Beside these studies, surveys, involving several farms were carried out mainly about pneumonia in pigs raised in closed buildings. A low space allowance per pig (less than 0.5m^2) was associated with high levels of pneumonia (Bäckstrom and Bremer 1978). Lindquist (1974) suggested 0.7 m^2/pig as minimal floor allowance to reduce pneumonia incidence. When farms with high prevalence of pneumonia were compared with farms with low prevalence a difference was found, although moderate, in stocking density (Pointon et al 1985): range of 83 to 120 kg liveweight/m^2 in case of low prevalence *vs.* 93 to 132 kg in case of high prevalence. The size of the groups remains debatable with a trend to get lesions in pigs raised in small groups, 12 pigs or less (Flesja et al 1982). In a prospective survey undertaken in France, batches of pigs were followed during finishing phase and then at slaughter (Madec and Tillon 1986). Among the 11 risk factors for respiratory tract lesions, space allowance and air space during the finishing phase were highlighted out. At least 0.75 m^2 and 3m^3/finishing pigs were recommended, respectively. Air quality and age-segregated rearing were found as key factors.

A cross-sectional survey performed in Belgium (Maes et al 2000) looked at the herd factors associated to the prevalence of four major respiratory pathogens in slaughter pigs. The number of pigs per pen and air space density were reported as risk factors (an increase in the number of pigs per pen implies a higher risk regarding Swine flu). The same authors also considered lung lesions (Maes et al 2001) and found that an increase in air space stocking was more likely to result in *pleuritis*. On several occasions poor air quality within buildings (ammonia, dust, endotoxin, bacterial load etc ...) was related to the severity of respiratory disorders and growth depression (Donham 1991, Robertson et al 1992, Hartung 1994, Wathes et al 2004). In turn those air conditions could be related to farm management and engineering factors. Pig density through different criteria (*i.e.*: m^2/pig, m^3/pig or m^3/kg of pig live weight) was found to be correlated with poor air quality (Donham 1991). The authors draw out recommendations for air quality but not for space allowance. In their list of factors weighed for their potential influence on the overall risk of enzootic respiratory diseases, Christensen et al (1999) made stocking density a priority but they did not give the required values for the latter. In the Netherlands an epidemiological study showed advantages in raising fattening pigs in small isolated compartments (holding 80 pigs), divided in small pens (Tielen 1989). In New-Zealand, Stärk (1998) in her attempt to find out risk factors for enzootic pneumonia also stated that the prevalence of lung lesions was negatively correlated with number of pigs per pen and per room (higher numbers associated with unfavourable health). Finally Done (1991) proposed a set of recommendations regarding the control of pneumonia in finish pigs. In his list he mentions medium size isolated compartments (150 pigs) with small pens (around 12 pigs), having at least 0.7 m^2/pig (dunging + lying are) and at least 3m^3/pig of air space. These last values dealing with space allowance frequently occur in literature. As far as enzootic diseases are concerned and especially respiratory diseases, the notion of infection pressure is believed to be involved (Stärk, 2000). Indeed, a dose-response relationship was experimentally demonstrated for some pathogens (Sebunya et al., 1983). Also there is a higher risk of disease transmission in larger groups of pigs in a given space as many pathogens are spread *via* pig-to-pig contact[(1)]. This can turn a relatively small infection into a severe outbreak when infection pressure contributes to spread.

The role of animal hygiene in Postweaning diarrhoea in pigs

The numerous and abrupt changes that occur at weaning make this period a real challenge to the piglet, although the ability of the pig to adapt to different environments is well known. In particular the adaptative capacity of the digestive tract has been investigated and found to be remarkable (Aumaitre et al., 1995). Physical changes in the size and shape of the organs have been observed during this period, profound modifications were detected in enzyme production and release (Pluske et al., 1997, Hedemann and Jensen 2004). Unfortunately, despite the natural ability of piglets to adapt, the conditions they experience on commercial farms sometimes can result in the challenge exceeding this capacity. The consequences can vary considerably but enteric disorders, (diarrhoea and related growth checks) are by far the most common signs of disruption.

Most of the bacterial pathogens associated with post-weaning enteric disorders are strains of enterotoxin-producing *E. coli*, and investigations can identify the main serotypes (Berschinger 1999). However those strains of *E. coli* are also found in the digestive tract of healthy pigs

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[(1)] According to the simple equation: $E = n^2 - n$
E = number of potential exchanges of particles between individual pigs in a given space (a pen ...)
N = number of pigs

(Fairbrother et al 1994, Celemin et al., 1995) and experimental reproduction of the disease as observed in the field, through *E. coli* inoculation was difficult (Wathes et al., 1989, Melin et al. 2000). The authors come to the conclusion that beyond the individual pig susceptibility, the environmental conditions the piglets are exposed to before and at weaning play the most important role. Therefore a number of studies were designed trying to clarify the role of the environment. The experimental trials paid special attention to nutrition and climate.

Space allowance was mainly considered in the early eighties. The authors concluded that 0.25 m^2/pig at post-weaning stage (between 10 and 25 kg live weight) was a best compromise regarding health maintenance and production criteria. More recently epidemiological surveys were performed to identify the on-farm circumstances associated to post-weaning enteric disorders. The risk factors for batches of piglets was found to comprise space allowance in terms of available surface, size of pens and space at the feeder but also other factors like creep-feed intake prior to weaning (Madec et al., 1998). A progressive increasing risk was found in particular when the number of pigs per pen, stocking rate and space at the feeder were >13 pigs, <0.30 m^2/pig and <7 cm, respectively.

At the farm level the factors involved are not independent. Certain housing systems tend to induce certain practices. Hence large pens were associated with more mixing of piglets from different litters at weaning. Statistical methods can evaluate the respective Odds Ratios for each of the factors. However in case of multifactorial diseases it is wise to adopt a rationale backed to a profile approach. A recent experiment was specifically designed to assess the interaction of stressors (*i.e.*: weaning, mixing etc… on the weaned piglet). The results indicated that although the stressors influenced the shedding of enterotoxigenic *E. coli*, the mechanism remained unclear (Jones et al., 2001).

Conclusion

Animal health results from a hugely complex balance where the micro-organisms are involved. Depending on the strength of the multiple synergistic as well as antagonistic forces which interact through cascades of events, the consequence in term of health will differ. Animal hygiene is due to preserve health and welfare through an early intervention *i.e.* prevention.

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