Health advantages of transition to batch management system in farrow-to-finish pig herds

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ABSTRACT: Sow batch management systems have become more popular due to advantages in labour planning, piglet batch sizes, all-in all-out practices and health management. The present study investigated the potential health advantages of 10 selected farrow-to-finish pig herds before and after transition from a one week batch management system to a four or five week batch management system. Five different animal categories (gilts, sows, piglets, growers and finishers) were sampled at three time points (T0, T1 and T2) before and after transition to a four or five week batch management system. Different matrices of the animals were collected: blood, nasal swabs and faeces. Several economically important diseases were monitored through serology: *Lawsonia intracellularis*, Porcine Reproductive and Respiratory Syndrome virus (PRRSv), *Mycoplasma hyopneumoniae*, *Actinobacillus pleuropneumoniae*; and PCR-testing: *Pasteurella multocida* dermonecrotic toxin (DNT) and *Brachyspira* species, especially the major pathogenic *Brachyspira hyodysenteriae*. Following serological analysis, the percentage of positive animals per category and sampling occasion were calculated. Health improvement based on serology was defined as the reduction in the percentage of positive animals for a specific disease in a specified animal category. All samples were negative for *P. multocida* DNT and *B. hyodysenteriae*. Little to no improvement could be observed for PRRSv. For *L. intracellularis* an improvement could be observed in piglets (71%) and growers (56%; $P < 0.05$). For both of the respiratory pathogens, *M. hyopneumoniae* and *A. pleuropneumoniae,* significant improvement was observed in finishers (34 and 24%, respectively). In growers, only *M. hyopneumoniae* showed a significant improvement (34%). In conclusion, the transition from a one week batch management system to a four or five week batch management system in the present herds resulted in a reduction of the percentage of seropositive animals for three of the monitored economically important diseases: *L. intracellularis*, *M. hyopneumoniae* and *A. pleuropneumoniae*.

Keywords: health status; monitoring; farrow-to-finish pig herds; group management

Batch management systems are relatively well-established in Belgian pig production. Until now, the three week batch management system, which was the first batch management system introduced in Europe (Mekerke and Leneveu 2006), has been the most widely used system. Batch management systems have become particularly popular due to their advantages in labour planning, increased batch size of weaned piglets and strict all-in all-out practices (Mekerke and Leneveu 2006). Besides the three week batch management system, four and five week batch management systems have been introduced during the last decade. One of the major advantages of four and five week batch management systems is their strict separation between consecutive batches with only one batch in the farrowing house at any one time and the potential improvement in animal health (Mekerke and Leneveu 2006). However, the latter advantage has of now only been suggested, and to the authors' knowledge has not yet been investigated.

Monitoring tools to assess the health status of different animal categories at farm level are quite diverse and may vary from conventional clinical observations over herd sampling programs – in-

cluding serology (Maes et al. 2001; Fraile et al. 2010; Hands et al. 2010; Meyns et al. 2010), bacteriological culture and PCR-testing (Hands et al. 2010) – to slaughterhouse checks (Fraile et al. 2010; Meyns et al. 2010). In many European countries, *Pasteurella multocida* (*P. multocida*) producing dermonecrotic toxin (DNT; Christensen and Mousing 1992; Christensen et al. 1994; Fablet et al. 2011), *Brachyspira hyodysenteriae* (*B. hyodysenteriae*) (Christensen et al. 1994), *Lawsonia intracellularis* (*L. intracellularis*) (Christensen et al. 1994), Porcine Reproductive and Respiratory disease virus (PRRSv) (Christensen and Mousing 1992; Christensen et al. 1994), *Mycoplasma hyopneumoniae* (*M. hyopneumoniae*; Christensen and Mousing 1992; Fraile et al. 2010; Meyns et al. 2010; Fablet et al. 2011) and *Actinobacillus pleuropneumoniae* (*A. pleuropneumoniae*; Christensen and Mousing 1992; Fraile et al. 2010; Meyns et al. 2010; Fablet et al. 2011), are considered to be the most important economic diseases in closed pig herds.

The dermonecrotic toxin (DNT) produced by some strains of *P. multocida* is crucial in the pathogenesis of progressive atrophic rhinitis (Chanter and Rutter 1989; De Jong 1992; Pijoan 2006). Monitoring of toxigenic *P. multocida* can be performed using the PMT ELISA or the more sensitive toxA PCR test (MacInnes et al. 2008). The prevalence of toxigenic *P. multocida* has been reported to be quite low (0 to 2%; Hariharan et al. 2000; Jamaludin et al. 2005; MacInnes et al. 2008).

Brachyspira hyodysenteriae, the cause of swine dysentery, occurs in most swine-producing countries and prevalence has recently increased in several European countries, including Belgium (Vyt et al. 2007).

Proliferative enteropathy is caused by *L. intracellularis* (McOrist et al. 1993). The currently available monitoring tools for the detection of *L. intracellularis* infections are serology and faecal PCR analysis (Knittel et al. 1998). Seroconversion after infection with *L. intracellularis* generally occurs two to three weeks after infection, resulting in two specific infection patterns: nursery and grower infection (Hands et al. 2010). Seroprevalence data revealed a high percentage (92.9 to 97.8%) of positive pigs at 20 to 23 weeks of age (Hands et al. 2010).

PRRSv has been identified as the cause of late-term abortions and stillbirths in sows, in conjunction with respiratory disease with immunodepression in weaned piglets and finishers (Christianson 1992; Collins et al. 1992). Seroconversion after PRRSv infection appears within five to 14 days and antibody titres increase rapidly to a maximum around four weeks post-infection (Labarque et al. 2000; Diaz et al. 2005). Within-herd seroprevalence of PRRSv in conventional farrow-to-finish pig farms in Belgium varied between 73 and 100% (Lefebvre et al. 2009).

Mycoplasma hyopneumoniae plays a central role in PRDC and is widespread in pig herds (Maes et al. 2008). Seroconversion to *M. hyopneumoniae* may occur up to 12 weeks post-infection (Morris et al. 1995; Sorensen et al. 1997b). Infection may already occur in the nursery unit (Calsamiglia and Pijoan 2000; Fano et al. 2007; Sibila et al. 2007; Villarreal et al. 2010) with seroconversion occurring much later (Andreasen et al. 2000). Recently, the within-herd prevalence of *M. hyopneumoniae* in slaughter pigs was found to be 79% in Belgium (Meyns et al. 2010), and 82% in Spain (Fraile et al. 2010).

Actinobacillus pleuropneumoniae is a primary pathogen that causes an acute fibrinous to necrotic pleuropneumonia in pigs at all ages (Sebunya and Saunders 1983; Gottschalk and Taylor 2006). For general *A. pleuropneumoniae* monitoring purposes, the detection of apxIV antibodies in the serum is currently the most frequently used serological method. Seroconversion to *A. pleuropneumoniae* may occur up to five weeks post-infection (Sorensen et al. 1997a) and occurs preferentially at 12 to 23 weeks of age (Chiers et al. 2002). Recent studies in slaughter pigs showed a within-herd prevalence of *A. pleuropneumoniae* of 63% in Belgium (Meyns et al. 2010), and 89% in Spain (Fraile et al. 2010).

The introduction of a batch management system should lead to a more structured approach in pig farm management with larger groups of piglets, less movement and mixing of piglets of different ages, and could therefore result in a better general herd health status.

Until now, little has been established regarding the health advantages of a four or five week batch management system. The objective of the present study was to follow the health status of 10 selected Belgian farrow-to-finish pig herds during their transition from a one week batch management system to a four or five week batch management system.

MATERIAL AND METHODS

Selection of pig herds

Ten Flemish farrow-to-finish pig herds were selected based on the following inclusion criteria: at least 100 breeding sows, 80% of fattening pigs

Table 1. Descriptive information on number of sows, type of batch management system (BMS) that was used during the study and reproductive performance (live born and weaned piglets/litter, weaned piglets per sow per year) of 10 selected Belgian farrow-to-finish pig farms to assess the potential health advantage after transition from a one week batch management system to a four or five week batch management system

Farm	Number of sows	BMS	Number of live born piglets per litter	Piglets weaned per litter	Piglets weaned per sow per year
A	130	4	11.50	10.07	23.26
B	325	4	12.10	9.81	22.17
C	110	5	11.00	9.90	21.40
D	300	4	12.20	10.70	26.23
E	130	5	10.97	9.67	21.65
F	200	4	10.30	9.18	21.65
G	200	5	11.89	10.46	23.68
H	500	4	11.86	9.79	23.50
I	240	4	12.21	10.60	25.20
J	140	5	12.61	11.11	26.90

remaining on site (sow herd location), no specific pathogen-free status, willingness of the pig farmer and his official herd veterinarian to cooperate during the entire study. Descriptive data on the number of sows, type of batch management system chosen and reproductive performance (number of piglets born and weaned per litter, number of piglets weaned per year and number of reproductive cycles per year) are given in Table 1. All pig herds had cross-bred sows, mainly based on a crossing of Large-White and Landrace (French Landrace, Danish Landrace). Sows were fed twice a day during pregnancy and three times a day in the farrowing house during lactation. General biosecurity status was moderate to low in all farms. Only two farms had specific hygienic requirements (hand hygiene, showering, farm-specific clothing), whereas the other farms only applied the basic regulatory biosecurity requirements (changing room with coverall and boots). The vaccination strategy in sows consisted of pseudorabies vaccination, combined *Erysipelothrix rhusiopathiae* and parvo vaccination, and PRRSv-vaccination with a live modified vaccine (strain dependent on farm: EU or US strain). Piglets were immunized against *M. hyopneumoniae* using a commercial bacterin during the suckling period.

Transition to batch management system

The choice of batch management system (four or five week) for each individual pig farm was based on farm-specific criteria: future investment plan with potential growth of sow numbers, available housing for critical animal subpopulations (e.g., farrowing crates, post-weaning facilities), possibility to manage labour peaks (e.g., farrowing, weaning, etc.), and the desired age of piglets at weaning (four week batch management systems always require weaning at three weeks of age). Six of the selected farms started a transition to a four week batch management system, whereas the other four changed to a five week batch management system. Following the choice of the farm-specific batch management system, a thoroughly detailed transition plan was drawn up containing the start date of transition, sow weaning and regrouping plan, gilt synchronization plan and further internal reorganization plans, if necessary. The selection was performed at the end of 2006. The first sampling took place between March and May 2007. All farms were sampled again one and two years after the start of the transition.

Sampling schedule

Within each herd, five animal categories were selected for representative sampling: gilts, older sows (> 2nd parity), weaned piglets at the end of nursery (9 to 11 weeks depending on farm situation), growers (< 45 kg) and finishers (> 80 kg). A total of 10 animals per age category were randomly sampled. Three different matrices were collected from each animal: blood, nasal swabs and faeces. Blood

was collected through puncture of the jugular vein. Nasal swabs were taken through deep intranasal swabbing of both nostrils with one nasal swab (culture swab containing Amies with charcoal; Venturi Transystem® Copan, Brescia, Italy). Faecal samples were collected rectally from five individual pigs per age category. The specific sampling schedule and the number of samples are detailed in Table 2. The three sampling times were specifically selected to provide baseline information of the herd health status (sampling before the start of transition (T0)), and to provide information during a sufficiently long period after the transition (one (T1) and two years (T2) after the start of transition).

Animal samples were selectively analyzed for several disease pathogens depending on the specific animal category and the disease relevance for the concerned age group or animal category. Different important pathogens were monitored: *L. intracellularis*, PRRSv, *M. hyopneumoniae*, *A. pleuropneumoniae*, *P. multocida* DNT and *Brachyspira* species, with *B. hyodysenteriae* as the major pathogen.

Sample analysis and interpretation of obtained results

The samples were transported under cooled (4 °C) conditions to the diagnostic laboratory (Animal Health Care Flanders, Torhout, Belgium). Upon arrival in the laboratory (one to three h after sampling), samples were immediately dispatched to specific analytical units for further processing.

Nasal swabs were plated out on non-selective Columbia blood agar plates and incubated at 37 °C for 24 h. Following incubation, plates with specific *P. multocida* colonies were further processed for DNT PCR analysis. First, positive cultures were lysed through heating (90 °C, 10 min). Following subsequent DNA extraction, detection of the chro-

Table 2. Sampling schedule for all three sampling timepoints (T0 – before transition, T1 – one year after transition and T2 – 24 months after transition), detailing the matrices (blood/serum, nasal swabs and faecal material), animal categories (gilts, older sows, piglets, growers and finishers) pathogens (*L. intracellularis*, PRRSv, *M. hyopneumoniae*, *A. pleuropneumoniae*, *P. multocida*, *Brachyspira* spp.), specific analytical tests and the number of samples collected

Sample type	Animal category	Pathogen that was monitored*	Analytical test	Number of samples
Blood/serum	gilts	*L. intracellularis* PRRSv *M. hyopneumoniae*	ELISA	10
	sows (> two litters)	*M. hyopneumoniae*		10
	piglets (10 week)	*L. intracellularis* PRRSv *A. pleuropneumoniae*		10
	Growers (14week)	*L. intracellularis* PRRSv *M. hyopneumoniae* *A. pleuropneumoniae*		10
	Finishers (> 80 kg)	*L. intracellularis* PRRSv *M. hyopneumoniae* *A. pleuropneumoniae*		10
Nasal swabs	piglets (6 week)	DNT *P. multocida*	PCR culture	12
	piglets (10 week)	DNT *P. multocida*		12
	growers (14 week)	DNT *P. multocida*		12
Fecal material	growers (14 week)	*Brachyspira* spp.	PCR faeces	5
	finishers (20 week)	*Brachyspira* spp.		5

*disease abbreviations: *L. intracellularis* = *Lawsonia intracellularis*, *M. hyopneumoniae* = *Mycoplasma hyopneumoniae*, *A. pleuropneumoniae* = *Actinobacillus pleuropneumoniae*, PRRSv = Porcine Reproductive and Respiratory Syndrome virus, DNT *P. multocida* = dermonecrotic toxine of *Pasteurella multocida*

mosomal toxA gene was performed using a commercial PCR test (Bactotype PCR amplication kit; Labor Diagnostik Leipzig, Leipzig, Germany), according to the manufacturer's instructions.

Faecal material from individual animals was pooled into a pool of five animals and subsequently DNA was extracted and amplified using the Adiavet® Brachy (Adiagene, Saint-Brieuc, France) PCR kit according to the instructions of the manufacturer. The final results of the PCR test were negative or positive with different options: *B. hyodysenteriae*, *B. pilosicoli*, *B. intermedius-innocens* and *Brachyspira* species. The sensitivity of the test was one copy of *Brachyspira* DNA according to the manufacturer's specifications.

Blood samples were incubated at room temperature for 12 h and following clotting, the supernatant serum was collected and distributed in individual vials (1 ml) for preservation through freezing (–80 °C) until analysis. Analysis of *L. intracellularis* was performed using the Bioscreen Enterisol® Ileitis kit. PRRSv, *M. hyopneumoniae* and *A. pleuropneumoniae* were analyzed using the Idexx HerdChek testkit: PRRSv, M. hyopn. Ab and App – ApxIV ELISA, respectively. Serological interpretation was based on the manufacturer's cut-off values and test interpretation criteria. Non-interpretable (NI) results were designated as negative (Hands et al. 2010), and the percentage of positive samples per sampling time point and animal category were calculated.

Statistical analysis

Statistical differences ($P < 0.05$) between time points T0–T1 and T0–T2 were analysed using repeated measures ANOVA (SPSS Statistics v.18; IBM®). Differences between batch management system at every time point (T0, T1 and T2) were analysed using a two-sided *t*-test assuming unequal variances. Differences were considered significant when *P*-values were lower than 0.05 (two-sided test).

RESULTS

Descriptive data of study population

Ten farrow-to-finish pig herds with 130 to 500 sows were included in the trial. Based on the characteristics of individual farms and future plans, six pig herds changed to a four week batch management system, whereas four herds chose a five week batch management system.

PCR test results

All nasal swabs tested negative for *P. multocida* DNT and no clinical signs of atrophic rhinitis were present on these herds at any of the sampling time points. All faecal samples in growers and finishers were negative for *B. hyodysenteriae*. Nevertheless, other *Brachyspira* species, such as *B. innocens-intermedia* and *B. murdochii* were detected, both before and after the transition.

Serological results

The results of the serological screening are presented in Table 3. For *L. intracellularis*, a reduction in the percentage of positive animals in both weaned piglets and growers could be observed at T2, although this difference was only significant in the growers. Furthermore, in growers, the impact of a transition to a five week batch management system had a greater positive impact on the serological reduction in *L. intracellularis* at both T1 (73%) and T2 (95%). At T1, a reduction could be observed in growers and finishers, but the improvement in finishers did not persist up to two years after transition onset. This was mainly due to a large significant difference between the batch management systems, with finishers in the five week batch management system showing a consistent decrease (39%) at T2. In gilts, no improvement in *L. intracellularis* infection status was observed.

For PRRSv, no significant reduction in the percentage of positive animals could be observed, except for the gilts, which had a slight improvement (5-6%), both at T1 and T2. At T1, weaners also showed a decreased prevalence (–18%), which, however, did not persist throughout the entire study.

The prevalence of *M. hyopneumoniae* decreased slightly in gilts (–5 and –12%) between T0–T1 and T0–T2. A significant reduction could be observed in both growers (–65 and –34%) and finishers (–28 and –34%). A marked difference in the impact of batch management systems was observed. In growers, the five week batch management system

Table 3. Serological results (expressed as % positive animals per disease and animal category) of 10 Belgian farrow-to-finish pig herds at the different sampling times (T0 – before transition, T1 – 12 months after transition and T2 – 24 months after transition to a four or five week batch management system) and the difference (expressed in % improvement or decline) as compared to T0. Significant differences ($P < 0.05$) between T0–T1 and T0–T2 are indicated with an asterix (*)

Disease	Animal category	T0	T1	T2	T1–T0 (%)	T2–T0 (%)
Lawsonia intracellularis	gilts	76	86	81	+13	+7
	piglets	7	9	2	+28	–71
	growers (45 kg)	43	22	19	–49*	–56*
	finishers (> 85 kg)	50	61	51	–20	+2
PRRSv	gilts	88	82	83	–6	–5
	piglets	55	45	61	–18	+11
	growers (45 kg)	71	83	72	+16*	+1
	finishers (> 85 kg)	80	84	89	+5	+11
Mycoplasma hyopneumoniae	gilts	56	53	49	–5	–12
	sows (> 2nd parity)	16	23	36	+43	+125*
	growers (45 kg)	49	17	32	–65*	–34*
	finishers (> 85 kg)	70	50	46	–28*	–34*
Actinobacillus pleuropneumoniae	piglets	57	44	65	–22	+14
	growers (45 kg)	34	22	35	–35*	+2
	finishers (> 85 kg)	67	52	51	–22*	–24*

resulted in a greater reduction (61% at T2), whereas in finishers, the four week batch management system showed better results (39% at both T1 and T2). Only older sows showed an increase in the number of positive animals throughout the study.

Actinobacillus pleuropneumoniae prevalence showed an overall decrease at T1 (–22 to –35%). However, this decrease (–24%) remained constant only in finishers, whereas in weaners and growers, there was a slightly increased prevalence, which was mainly due to the four week batch management system. In the five week batch management system, both growers and finishers showed a very consistent significant reduction (46 and 58%) at both T1 and T2.

DISCUSSION

The present study assessed the potential health advantage of a transition from a conventional one week batch management system to a four or five week batch management system in 10 Flemish farrow-to-finish pig herds. The results showed that for some of the monitored pathogens, such as *L. intracellularis*, *M. hyopneumoniae* and *A. pleuropneumoniae*, an improvement in health status was observed after the change in management system. Moreover, the five week batch management system showed more consistent improvement over time as compared to the four week batch management system. This may be due to the longer interval between batches and the reduction in number of batches present in the nursery (Chouet et al. 2003). Toxigenic *P. multocida* was absent in all herds and all collected samples. This is in accordance with previous studies, showing a very low prevalence of this pathogen (Jamaludin et al. 2005; MacInnes et al. 2008). Besides the absence of diagnostic detection of the toxA gene of *P. multocida*, there were no clinical signs which could indicate problems with progressive atrophic rhinitis in the herds. Although *B. hyodysenteriae* prevalence is increasing in Belgium (Vyt et al. 2007), the pathogen was not detected. Some minor pathogenic *Brachyspira*, including *B. innocens-intermedia* and *B. murdochii*,

could be detected, although no clinical signs possibly associated with these pathogens were observed throughout the entire study period. Transition to a batch management system did not have any impact on the presence nor prevalence of these *Brachyspira* species.

For *L. intracellularis*, all farms were seropositive and the average percentage of positive animals was between 43% in growers and 76% in young gilts, which is much lower than the 93 to 98% reported in 20 to 23 week old finishers by Hands et al. (2010) in Great Britain and Ireland. From the present study, it can be concluded that in the studied herds, the infection pattern described by Hands et al. (2010) was a grower infection, since seroconversion only occurred after the nursery period. After transition to a batch management system however, a clear reduction in the percentage of positive animals could be observed in the weaners and growers. Less mixing of piglets and more discipline in cleaning have been shown to have an impact on the environmental infection pressure (Chouet et al. 2003).

In the present study, PRRSv was monitored in gilts, piglets, growers and fattening pigs. The high within-herd prevalence (55–88%) at the start of study was in accordance with a recent seroprevalence study in Belgium (73–100%; Lefebvre et al. 2009). Little to no improvement in animal prevalence could be observed following transition to a batch management system. These results can be explained by the lack of additional biosecurity measures to reduce PRRSv circulation within the herds. Moreover, in several herds, severe outbreaks of PRRSv – especially in piglets and finishers – were seen during the study period. In contrast, one specific herd (herd C) had a comparable low prevalence of PRRSv in piglets, growers and finishers at T0 and T2, which indicates that specific farm-associated management practices and internal biosecurity measures have a significant impact on the control or spread of PRRSv.

For *M. hyopneumoniae*, increased prevalence could be observed in gilts as compared to older sows throughout the entire study. This is in accordance with observations by Calsamiglia and Pijoan (2000), showing a higher number of young sows having *M. hyopneumoniae* carrier status. Transition to a batch management system had little to no impact on the prevalence of *M. hyopneumoniae* in gilts (–5 to 6%) and older sows (+43 to 125%), whereas in growers and finishers, a decrease in animal prevalence (–34%) could be observed at T2. Management factors and housing conditions have a significant impact on the spread and control of *M. hyopneumoniae* (Maes et al. 2008).

Sows and gilts were not monitored for *A. pleuropneumoniae* as previous studies have shown that most farms are endemically infected (Chiers et al. 2002). In contrast with Chiers et al. (2002), the seroprevalence of *A. pleuropneumoniae* at the end of nursery (9 to 11 weeks of age) was rather high. This may be related to high levels of maternally-derived antibodies. In growers, a lower animal prevalence was present followed by seroconversion in the finishers, which is well in accordance with the seroconversion observed by Chiers et al. (2002) in 16-week old pigs.

In the present study, only 10 farrow-to-finish pig farms were selected for the monitoring of the transition to a four or five week batch management system and no control farms which remained unchanged in their management systems were included. Although the herds were not randomly selected, they are considered based on the herd characteristics, to be representative for other pig herds in Belgium. Also, it is not known which management factors associated with the transition to a batch management system have caused the observed improvements for some pathogens. To answer these questions, further studies using a different study design should be conducted.

In conclusion, the transition of pig herds to a batch management system seems to postpone or slow down the seroconversion of pigs for *L. intracellularis*, *M. hyopneumoniae* and *A. pleuropneumoniae*. This allows the farmer the possibility of vaccinating the pigs before they come in contact with the pathogen and it also allows more time for the pigs to build up immunity before infection. The differences observed between the four and five week batch management systems for several pathogens (*L. intracellularis*, *M. hyopneumoniae* and *A. pleuropneumoniae*) may confirm this hypothesis. Therefore, these results indicate that the transition from a one week batch management system to a four or five week batch management system could have protective effects with regard to several economically important pathogens.

Acknowledgements

The authors greatly appreciate the financial support of Veepeiler-varken (project PVP-06-05)

(Sanitary Fund Pigs, Brussels, Belgium) and Janssen Animal Health (Beerse, Belgium). The technical support of all laboratory technicians (Animal Health Care Flanders, Torhout, Belgium) involved in the study and the participant pig farmers throughout Flanders is also much appreciated.

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Received: 2011–10–07
Accepted after corrections: 2012–02–12

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