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Original article

An abattoir survey of pneumonia lesions in slaughter pigs in Cebu, Philippines

Ruby H. Destajo*, Rhia Jean A. Bolo, Resalie A. Jabonero, and John Paul C. Alcuirez

Cebu Technological University - Barili Campus

ABSTRACT

A cross-sectional study was conducted in four selected abattoirs from December 2018 to February 2019 to determine the prevalence of gross swine enzootic pneumonia - like lung lesions in slaughter pigs in Cebu, Philippines. A total of 954 pig lungs were evaluated using the Goodwin's lung score for enzootic pneumonia. Lesions indicative of pneumonia were found in 85.43% of the lungs examined. Higher prevalence was observed in fatteners (68.87%) and in commercial slaughter pigs (44.76%). Prevalence in the three sites were 84.56% (Site1), 97.49% (Site2), and 77.20% (Site3). Site 2 had the highest prevalence (55.23%) of severe gross lung lesions observed while Sites 2 and 1 had 47.23% and 21.08% respectively. Findings in this study showed a high prevalence of pneumonia in slaughter pigs as observed in other countries, confirming the status of enzootic pneumonia as a major respiratory problem endemic in swine herds worldwide.

KEYWORDS: *Mycoplasma hyopneumoniae, enzootic pneumonia, swine, lungs*

1 INTRODUCTION

Swine production is the leading animal industry in the Philippines and ranked second only to rice in contribution to the total agricultural production of the country (DOST PCAARRD, 2016). The national inventory of hogs reached 12.6. million heads in 2018, consisting of 64% backyard and 36% commercial swine inventories (PSA, 2018). In Central Visayas, Cebu leads the production of hogs and is also the primary producer of roasted pigs ("*lechon*"). This growing local demand plus the increasing annual demand for pork make it important to understand the impact of lung lesions in swine herds to maximize profitability in swine production.

Swine disease problems encountered during production can be monitored through slaughter checks. Meat inspection is perceived as a sanitary control of slaughter animals and meat (Edwards et al., 1997). It ensures that only healthy animals are slaughtered and that the meat passed for human consumption is free from disease, wholesome, and are of no risk to human health (Herenda et al., 1994). The abattoir is thus an important control point for detecting problems that impact public and animal health (Falk et al., 1991; Merialdi et al., 2012) and a suitable source of data for monitoring diseases and conditions concerning animal health and welfare (Stärk *et al.*, 2014). When high-quality data are routinely collected, they can serve as a basis for epidemiological studies (Decaudin *et al*., 2017). Thus, periodic slaughterhouse checks can increase awareness on production problems and provide a mechanism in assessing effectiveness of disease control measures (Hilley, 1982).

The most common swine respiratory disease that can be monitored through slaughterhouse checks is pneumonia (Osborne et al., 1981; Falk et al., 1991; Merialdi et al., 2012). Enzootic pneumonia (EP), a disease caused by *Mycoplasma hyopneumoniae (M hyo)* (Goodwin et al., 1967), is present in major swine-raising countries (Merialdi et al., 2012). Transmission from the sow can occur before weaning (Vigre et al., 2003) but clinical signs and lesions are more commonly observed in animals between 30 to 40 kg and 100 kg (Kobisch, & Friis, 1996) or when they are 3 to 6 months old (Laber et al., 2002). Uncomplicated EP produces a persistent, chronic dry cough with high morbidity but low mortality (Laber et al., 2002). Pigs suffer from poor growth performance but the majority become asymptomatic carriers (Byrt, Heap, & Pointon, 1985; Taylor, 1999). Lesions produced are localized either in the cranioventral or dorsocaudal area of the lungs (Dottori, 2013). *M hyo* is identified as a significant primary pathogen in the development of porcine respiratory disease complex (PRDC), a complex respiratory problem whose severity depends on the presence of co-infecting microorganisms (O'Connor et al., 2013).

Pig lung scoring is an important instrument and a practical way to evaluate the status of respiratory health of the herd in a single visit (Quilitis et al., 2016). It categorizes gross pathological lesions observed during slaughter and aids in recognizing chronic lung problems and active respiratory diseases suffered by the animal prior to slaughter (Ostanello *et al*., 2007; Van Alstine,

*corresponding author: ruby.destajo@ctu.edu.ph
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2012 as cited by Alawneh *et al*., 2018).

Evaluation of lung lesions in abattoirs is a common practice in many countries and is widely used to estimate the severity and prevalence of respiratory diseases. Lung lesion monitoring studies have already been conducted elsewhere in the country but information on the prevalence of respiratory lung lesions of slaughter pigs in Central Visayas remain scarce. This study aims to establish a baseline information on the prevalence of EP-like lesions among slaughter pigs in Cebu and its associated risk factors.

2 MATERIALS AND METHODS

Abattoir Selection

Four abattoirs located in three different sites were selected by convenience prior to the conduct of the study. Approval from corresponding abattoir management was obtained prior to the conduct of the study. Site 1 abattoir was a locally managed and accredited government-managed slaughterhouse in the City of Talisay, Cebu. Site 2 involved two private commercial abattoirs in Cebu City which regularly slaughtered pigs for *lechon* while Site 3 was a government managed slaughterhouse in Carcar City.

Slaughterhouse visits were conducted at random for two to three days weekly for about eight weeks. Slaughterhouse visits depended on the schedule of slaughter in each abattoir. Night time slaughterhouse visits were conducted between 8:00 pm to 12:00 am while dawn visits were done between 1 to 3 am. In Site 3, visits were conducted during the day, depending on the schedule of the slaughter.

Lung Examinations

Examinations were conducted from December 2018 to February 2019 at the three sites. Lungs were randomly selected and immediately assessed visually for pneumonia. Pneumonic lungs were evaluated by examining their color (plum to gray) and consolidation in the apical, cardiac, accessory and/or diaphragmatic lobes of the lungs. Limited information available about the origin, age, and production type were also obtained for reference.

Pneumonia lesions were estimated using the 55' lung scoring system (PCAARRD, 2015) also known as the Goodwin Mycoplasma lesion score (Goodwin, 1972). The lungs were visually appraised for dark purplish areas of consolidation occurring in the different lobes and scored as follows: right apical (0-10), right cardiac (0-10), right diaphragmatic (0-5), left apical (0-10), left cardiac (0-10) and left diaphragmatic (0-5) and accessory (0-5) lobes. Prevalence of pneumonia was calculated as:

$$\frac{\text{No. of lungs with pneumonia}}{\text{No. of lungs examined}} \times 100$$

Classification for the severity of SEP was based on Burch (2007): mild (5-9), moderate (10-14), severe (15-19), very severe (20-55).

Statistical Analysis

Data were entered into Microsoft Excel® for tabulation and descriptive statistics. Variables for risk factors such as age group (starters, fatteners), production type (backyard and commercial), and abattoir site (sites 1, 2, and 3) were evaluated using two-stage analysis. Mean scores per abattoir were compared using one-way ANOVA. Prevalence of severe and very severe scores were compared using the chi-square test. Level of significance was set at 0.05.

3 RESULTS AND DISCUSSIONS

A total of 954 lungs were examined from three collection sites from December 2018 to February 2019 (Table 1). Of the total number examined, 42.77% were from site 1, 25.05% from site 2, and 32.18% from site 3. Site 3 had the highest proportion of starter (55%, 110/200) and backyard (47.23%, 230/487) pig lungs examined while site 1 had the highest proportion of finisher (49.73%, 375/754) and commercial (57.17%, 267/467) pig lungs examined.

Table 1. Proportion of pig lungs examined per abattoir site from Dec. 2018 to Feb. 2019.

Variable	Site 1 (%)	Site 2 (%)	Site 3 (%)	N
Starter	33 (16.50)	57 (28.5)	110 (55.00)	200
Finisher	375 (49.73)	182 (24.14)	197 (26.13)	754
Backyard	141 (28.95)	116 (23.82)	230 (47.23)	487
Commercial	267 (57.17)	123 (26.34)	77 (16.49)	467
Total	408 (42.77)	239 (25.05)	307 (32.18)	954

Mean score and prevalence of SEP-like lung lesions is presented in Table 2. Mean score for all the lungs examined was 13.47. Range was 0 to 55. Pneumonic lesions were observed in 85.43% of the pig lungs examined and 48.85% had high to very high scores. Mean scores for age group and production type were the same. Mean scores between site 1 and site 2 and between site 1 and 3 differed significantly but not between sites 2 and 3. Pneumonic lesions were found in 79% of the starter pig lungs and 87.14% of the fattener pig lungs examined. Pneumonic lesions were also present in backyard (79.67%) and commercial (91.43%) pig lungs examined. Site prevalence of pneumonic pig lungs were 84.56% (Site 1), 97.49% (Site 2), and 77.20% (Site 3). Overall, prevalence of severe and very severe lesion scores were less than 50% of the sample population, except in Site 2.

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Table 2. Mean score and prevalence of SEP-like lung lesions among the pig lungs examined according to age group, production type, and abattoir site.

	Mean SEP-like lesion scores	% of lungs affected by SEP-like lesion	% of lungs with severe to very severe SEP scores	No. Pig Lungs Examined (N)
Age Group				
Starters	13.10	79.00	34.00	200
Fatteners	13.56	87.14	39.12	754
Production Type				
Backyard	13	79.67	37.58	487
Commercial	13.95	91.43	38.54	467
Abattoir Site				
Site 1	8.94[a]	84.56	21.08	408
Site 2	17.58[b]	97.49	55.23	239
Site 3	16.30[b]	77.20	47.23	307
Over-All	13.47	85.43	38.05	954

a,b - significantly different at p<.05, ANOVA

Prevalence of SEP lung scores is presented in Table 3. Only 33.23% of the pig lungs examined were considered normal. Low, moderate, severe, and very severe score prevalences were 15.3%, 13.42%, 9.22%, and 28.33% respectively. Generally, a higher proportion of fattener pig lungs were examined compared to starter pig lungs but the proportion across lung score classifications remains the same. Similarly, the proportion between backyard and commercial pig lungs did not vary significantly. Comparison of the classification of the lungs examined however varied according to abattoir site (X^2=24.6165, df=6, p=.0004).

Table 3. Prevalence of SEP lung scores by age group, type of production, and abattoir site.

			Prevalence (%)						
CLASS	N	%	Starter	Fattener	Backyard	Comm	Site1	Site2	Site3
LOW	146	15.30	20.55	79.45	41.10	58.90	48.63	29.45	21.92
MOD	128	13.42	28.13	71.88	54.69	45.31	35.94	22.66	41.41
SEV	88	9.22	18.18	81.82	55.68	44.32	27.27	39.77	32.95
VSEV	275	28.83	18.91	81.09	48.73	51.27	22.55	35.27	42.18
NORM	317	33.23	20.82	79.18	54.89	45.11	64.67	11.04	24.09

SEP Scores: Low (5-9), Moderate (10-14), Severe (15-19), Very Severe (20-55), Normal (0-4)

The study aimed to provide baseline information on the prevalence of enzootic pneumonia-like lesions in Cebu pig production through abattoir examination of pig lungs utilizing the 55 Scoring System. Of the 954 lungs examined, about 21% of the pigs examined were starters and 79% were fatteners. This proportion reflects the higher percentage of fatteners (>10 weeks) being slaughtered for pork meat compared to starter pigs (≤10 weeks of age) which are usually slaughtered to meet the high demand for "lechon" or roasted pig.

The term "*lechon"* is a Spanish word that refers to a slowly roasted suckling pig stuffed with spices such as onions, garlic, and lemongrass. It is one of the most popular dishes in the Philippines and is traditionally served whole on a platter (https://www.tasteatlas.com/lechon). Major life events or feasts or community activities of a Filipino are never complete without a *lechon*. Nowadays lechon sizes may vary from *lechon de leche* (5-10 kg), small (10-15 kg), medium (15-20 kg), large (20-25 kg), and extra-large (25-30 kg) (Bondoc *et al*., 2017). Younger pigs are more preferred because they have more tender meat than bigger and older pigs whose meat become tough and skin thicker. A *lechon* with scrumptious and succulent meat as well as a crunchy and crispy skin is generally preferred by the Filipino community. It is for this reason that the proportion of starter pigs being slaughtered is usually higher in abattoirs that cater to slaughtering pigs for *lechon*.

Site 3 had the highest number of starter pigs slaughtered during the study period as the municipality where the abattoir is located is known to produce delicious *lechon* in Cebu province. Among the three sites, site 1 had the highest proportion of fattening pigs slaughtered (91.91%) due to its bigger slaughtering capacity and close proximity to metropolitan Cebu where demand for pork meat is very high.

Based on several studies (Lium & Falk, 1991; Meyns *et al*., 2011; Merialdi *et al*., 2012), the most frequent findings in pig lungs at the abattoir are cranioventral consolidation or enzootic pneumonia-like lesions caused by *M. hyo*. Gross lung lesions associated with SEP consist of cranioventral lung consolidation, seen as purple to grey areas, and distributed bilaterally in the apical, cardiac, accessory, and cranial parts of the diaphragmatic lobes (Garcia-Morante *et al*., 2016). Recovering lesions are characterized by interlobular scar retractions which are resolved 12–14 weeks after infection (Maes *et al*., 2008). According to Piffer (1981), pigs aging from 3 to 12 weeks are equally susceptible to *M. hyo.*

Interestingly, in this study, a high proportion of pig lungs were found positive for enzootic pneumonia-like lesions (85.43%). Prevalence of SEP-like lung lesions was relatively higher in fatteners (87.14%) than in starters (79%). Prevalence was also relatively higher in commercial pigs (91.43%) than in backyard pigs (79.67%). The higher prevalence in fatteners is attributed to the early onset of infection in the starter stage which continues on to the fattening stage and some pigs being infected in the fattening stage, developing lesions close to slaughtering (Ostenello *et al.,* 2007). The higher prevalence of SEP-like lesions in commercial pigs is similar to those observed by Alawne *et al.* (2013a, 2018b) in two major pig-producing provinces (Bulacan and Pampanga) in Region 3 of the Philippines. Management- and environment-related factors such as stocking density and quality of the pen environment could play a role as the problem is respiratory in nature. Same batches of slaughter pigs from commercial farms share the same

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environmental rearing conditions and have similar respiratory problems which just may vary in severity.

The mean SEP lung score of all the pig lungs examined was 13.47. Mean lung scores according to the abattoir site was 8.94 (site 1), 17.58 (site 2), and 16.3 (site 3). The mean lung score for site 1 was lower than the study mean SEP lung score while those for sites 2 and 3 were relatively higher. A greater proportion of lungs classified as severe and very severe were examined in sites 2 and 3. These differences could be attributed to the differences in the origin of the pigs submitted for slaughter in the abattoir. Majority of the pigs slaughtered in these sites were from around the area where the abattoir is located. Site 1 however is a triple A category slaughterhouse and accepts pigs from various parts of Cebu.

External evidence of pneumonia is often minimal and all pigs that appear apparently healthy but harbor the disease can get slaughtered. Fatteners have high scores since many of them could have been infected early in life. Resolution of pulmonary lesions usually takes several weeks and the pig may still harbor the pathological evidence of the disease at the time of slaughter. Enzootic pneumonia is a multifactorial disease and a number of management factors have been implicated in its development and persistence in a pig population (Maes *et al*., 1996). Transmission of *M hyo* is typically enhanced in highly dense populations or large herd size as the condition promotes direct pig-to-pig contact.

The findings in this study indicate that the prevalence of pneumonia in Cebu is high. Pneumonia may occur in both backyard and commercial pigs due to the multifactorial nature of the disease. Infection can start early in the production cycle and still exist at the time of slaughter. Due to this, fattener pigs often have higher prevalence of pneumonia and are more likely to harbor more severe forms of the disease. The high prevalence among slaughter pigs suggests that the majority of the pigs in Cebu, as in other regions in the Philippines, are exposed to the major swine respiratory pathogens regardless of their stage in production cycle and type of production.

Slaughter checks thus remain a very important procedure for monitoring the prevalence of respiratory and other diseases in livestock animals. It is recommended that further studies be conducted on the identification of potential risk factors associated with high lung scores for pneumonia and other respiratory lesions at the farm level or investigate the possible relationship between severity of gross pneumonia lesions and isolation of respiratory pathogens in order to increase awareness on the impact of respiratory diseases on productivity and encourage improvement in on-farm control programs.

Ethical Statement

As the study did not involve handling or manipulating live animals, the study was issued exemption from IACUC approval (No. EXACUC2018-BRL-01 to 03). Animal parts examined came from pigs that were slaughtered at both government-run and private abattoirs.

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