Peer reviewed **Brief Communication**

The evolving US swine industry

Grzegorz Tarasiuk, DVM; Pam Zaabel, DVM; Marta D. Remmenga, PhD; Kathleen C. O'Hara, DVM, MPVM, PhD; Fangshu Ye, PhD; Marisa Rotolo, DVM, PhD; Jeffrey J. Zimmerman, DVM, PhD

Summary

The US swine industry has evolved toward large, integrated production systems and increased efficiency and sustainability, which also impacted disease ecology. A survey assessed the diversity of US barn sizes and pen designs. This report describes the results and discusses factors that may promote disease persistence in these changing conditions.

Keywords: swine, survey, United States swine industry, pen size, barn design

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Resumen - La evolución de la industria porcina estadounidense

La industria porcina estadounidense ha evolucionado hacia grandes sistemas de producción integrados, con una mayor eficiencia y sostenibilidad, lo que también impactó la ecología de las enfermedades. Una encuesta evaluó la diversidad del tamaño de los edificios, y los diseños de los corrales en las granjas de los Estados Unidos. Este reporte describe los resultados, y analiza los factores que pueden promover la persistencia de las enfermedades en estas condiciones cambiantes.

Résumé - Évolution de l'industrie porcine américaine

L'industrie porcine américaine a évolué vers des gros systèmes intégrés de production, avec une augmentation de l'efficacité et de la durabilité, mais ayant également un impact sur l'écologie des maladies. Un sondage a évalué la diversité de la taille des fermes américaines et du design des enclos. Ce rapport décrit les résultats et discute des facteurs qui peuvent favoriser la persistance de maladies dans ces conditions changeantes.

Pigs (*Sus scrofa*), domesticated perhaps as early as 10,000 BC, were common to early agrarian societies throughout the Middle East and Europe.[1,2] Because they are largely self-sufficient, pigs were allowed to range freely on pastures and in woodlands; a fact particularly well-documented in art and literature from the Middle Ages.[3] Pigs were not native to North America and were introduced by Christopher Columbus and other early explorers and settlers.[4] They quickly adapted to the New World and by 1847 the US pig population reached approximately 35 million (as opposed to the human population estimated to be 20 million).[5] Beginning in the 19th century, producers began to provide small shelters (2.4 m × 2.4 m or smaller) called "cots" or "colony houses" in pastures to protect animals from adverse weather conditions.[6] Constructed by the farmers themselves, or available in local lumberyards, cots were cheap, lightweight, and easily moved as animals were rotated between pastures.[6]

Experiments in the early 1900's led Danish producers to conclude that indoor housing ("intensive" production) provided more efficient use of land, protected animals from weather, eliminated fighting, and improved feed conversion.[7] In 1919, Spencer[8] commented on a 2-story barn he observed near Aarhus, Denmark, in which the pigs were fed downstairs and slept in an upstairs area they reached by walking up a ramp.

In the northern regions of the United States, the adoption of indoor housing was driven by the fact that newborn piglets could only survive if farrowed in the summer months. Because farrowing was seasonal, this periodically resulted in an excess supply of market-weight "summer pigs" and, consequently, low prices. To break this seasonal cycle, producers began to implement indoor production as a way to improve newborn piglet survivability in the colder months and create the opportunity to market pigs throughout the year.

For most of the 20th century, pig barns in the northern regions of the United States were similar in design, ranging in size from 2.4 m × 4.2 m to 7.3 m × 14.6 m, with pen sizes typically 1.8 m × 2.4 m or 2.4 m × 2.4 m, and breeding barns up to 8.5 m × 24.4 m.[6,9] Although extensive (outdoor) production remained in wide use, O. Burr Ross' writing in 1960 was prescient:

> While the practicality of confinement systems of swine production has been demonstrated over and over again by research institutions, universal acceptance by swine producers has been slow. I believe most of the hogs of tomorrow will be raised under some sort of confinement program.[6]

GT, JJZ: Department of Veterinary Diagnostic and Production Animal Medicine, College of Veterinary Medicine, Iowa State University, Ames, Iowa.

PZ, MR: National Pork Board, Des Moines, Iowa.

MDR, KCO: US Department of Agriculture Animal and Plant Health Inspection Service-Veterinary Services Center for Epidemiology and Animal Health, Fort Collins, Colorado.

FY: Department of Statistics, Collage of Liberal Arts and Sciences, Iowa State University, Ames, Iowa.

Corresponding author: Dr Grzegorz Tarasiuk, Veterinary Medical Research Institute (Building 1), 1907 ISU C Drive, College of Veterinary Medicine, Iowa State University, Ames, Iowa 50011; Tel: 515-294-4751; Email: **tarasiuk@iastate.edu**

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These words were prophetic and confinement production became the norm in the United States and elsewhere. Concurrent with the transition from outdoor to indoor production, the swine industry changed from predominantly small, individual farrow-to-finish herds to large, specialized production operations.

The progression toward larger farms necessitated changes in housing and management systems and led to the emergence of 2- and 3-site production systems.[10] The first multi-site farm in the United States was constructed in 1988, but by 1995, 60% of production systems with more than 10,000 pigs in inventory were designed as multi-site systems.[10] This evolution process continues with the new generation of confinement facilities. We will learn much about the current US industry, ie, type, size, number, and location of US swine farms, as the data collected through the 2022 US Department of Agriculture (USDA) Census of Agriculture are released. The objective of this research was to supplement the census with a snapshot of current barn designs, in terms of the number of pigs per pen and per barn, in the US swine industry.

Materials and methods

Survey design

The objective of the survey was to collect information on the mean number of pigs per pen and total barn capacities on production sites in the United States. The Iowa State University Office of Research Ethics determined that Institutional Review Board approval was not required because the survey collected no information about people. Participation in the survey was voluntary and efforts were made to include individual pig producers, integrated production companies, and swine veterinarians, ie, no restrictions were placed on participants in terms of scale of production. Two questionnaires, one for swine producers and one for swine veterinarians, were published online using Microsoft 365 Forms and made available from February 2, 2022 to April 14, 2022. Using email listservs and conference announcements, the questionnaire for producers was distributed under the auspices of the National Pork Board and the questionnaire for veterinarians was distributed through the American Association of Swine Veterinarians. Participation was also solicited in a widely distributed electronic article published by the *National Hog Farmer* on March 1, 2022, with a link provided to the online survey. Finally, the Iowa State University Veterinary Diagnostic Laboratory solicited participation from all clients who had ever submitted one or more swine-related cases.

Data analysis

Survey responses from veterinarians and producers were analyzed separately. For exact numeric responses, eg, the number of "Farm sites represented", percentiles were calculated using Microsoft Excel. Means and percentiles for the mean, maximum, and minimum respondent-summarized values were also calculated using Microsoft Excel for survey questions such as the "Average number of sows per pen", "Maximum number of grower-finisher pigs per barn", or "Minimum number of pens in a grower-finisher barn". The mean number of growing pigs per pen was calculated by dividing the "average number of grower-finisher pigs per barn" by the "average number of pens in a grower-finisher barn" for each individual response. The means (95% CI) and percentiles for these estimates were calculated using R Studio[11] (version 42023.12.1+402).

Results

A total of 147 swine producers provided responses to the survey (Table 1). Among 134 respondents providing location information, 77 were from the US North Central region (Illinois, Indiana, Iowa, Minnesota, Nebraska, North Dakota, South Dakota, and Wisconsin), but all areas of the United States were represented. The survey represented a wide range in the number of production sites managed by a respondent, eg, the median value was 2 production sites, but respondents at the 90th percentile reported 60 farm sites. The majority of producers (n = 99; 67.3%) had breeding herd(s) on their farm(s). Among this group, 65 (65.7%) reported using pen gestation. The mean number of sows per pen was 30, but respondents at the 10th percentile reported 4 sows/pen versus 65 sows/pen at the 90th percentile. Likewise, most producers (n = 130; 88.4%) raised grower-finisher pigs, with means of 26 pens/barn and 1333 pigs/barn, respectively. The mean number of pigs per pen was calculated as 75 (95%CI, 57-93). The individual calculated values ranged from 11 (10th percentile) to 146 (90th percentile).

A total of 73 swine veterinarians provided responses to the survey (Table 2). The median number of production sites personally overseen by veterinary respondents was 55; the median number of production sites serviced by the respondents' clinics was 150. The majority of veterinarians (n = 54; 74.0%) worked with breeding herds that utilized pen gestation. Among these herds, the mean number of sows per pen was 37, with 10 sows/pen at the 10th percentile and 88 sows at the 90th percentile. The mean number of pigs per pen in nurseries, wean-to-finish, and grow-to-finish pig sites was 107, 94, and 82 pigs/pen, respectively. All survey participants (n = 73) used oral fluid sampling for disease surveillance.

Discussion

Swine producers achieved major gains in efficiency and sustainability over the course of the 20th century while, simultaneously, the industry underwent a major demographic shift. For example, in 1987, 8% of US pigs were on production sites housing ≥ 5000 head vs > 72% in 2017 (Table 3).[12-15] The most remarkable period of change occurred between 1992 and 2009 when, as a result of the growth of multi-site production and improvements in productivity, there was a > 850% increase in the number of hogs sold or removed from production sites.[16]

The shift toward larger swine operations justified investment in technology and technological innovations. These advancements, in turn, reduced the cost of production and labor. For example, between 1992 and 2015, production costs were estimated to have decreased by 59% to achieve 100 pounds of weight gain.[16] In the same period, labor declined by 83% to produce 100 pounds of weight gain.[16] Over a slightly longer time frame (1960 to 2015), the US swine industry achieved major improvements in efficiency and sustainability: feed conversion went from 4.5 to 2.8 pounds of feed per pound of gain, weaned pigs per litter increased from 7 to 10, land use (99% of which is used for feed production) was reduced by 75.9%, water use decreased by 25.1%, global warming potential decreased by 7.7%, and energy use decreased by 7%.[17]

The remarkable improvements that were achieved in productivity and sustainability were largely made possible by the technification and efficiencies made possible by economies of scale. Large, specialized hog operations increased production efficiency and sustainability, but

Table 1: Summary of swine producer responses to pen size survey

Survey questions	Responses	Percentiles					Mean
		10th	25th	50th	75th	90th	
1. Are you a pig producer?	147	NA	NA	NA	NA	NA	NA
2. How many farms are represented in your responses?	147	1	1	2	10	60	96
3. Do you have breeding herd(s)? If yes, answer 4.	Yes (99)	NA	NA	NA	NA	NA	NA
4. Do you house sows in pen gestation? If yes, answer 5-7.	Yes (65)	NA	NA	NA	NA	NA	NA
5. Average No. of sows/pen	64	4	8	12	43	65	30
6. Maximum No. of sows housed in each pen	64	6	10	20	50	170	51
7. Minimum No. of sows housed in each pen	64	1	2	6	10	48	17
8. Do you raise grower-finisher pigs? If yes, answer 9-14.	Yes (130)	NA	NA	NA	NA	NA	NA
9. Average No. of grower-finisher pigs/barn	129	30	500	1200	2000	2500	1333
10. Maximum No. of grower-finisher pigs/barn	128	39	225	1200	2400	4000	1605
11. Minimum No. of grower-finisher pigs/barn	123	14	30	550	1000	2120	748
12. Average No. of pens in a grower-finisher barn	125	4	10	20	40	48	26
13. Maximum No. of pens in grower-finisher barns	125	4	13	31	49	79	37
14. Minimum No. of pens in grower-finisher barns	126	2	5	10	20	40	16
Grower-finisher pigs/pen*	124	11	25	43	94	146	75
	≥ 2 areas		**NC†**	**NE‡**	**SC§**	**SE¶**	**W****
15. In what area of the country do you have production? No. responses.	7		77	19	10	6	15

* Grower-finisher pigs per pen was calculated by dividing the individual responses of question 9 by question 12.

† North Central (NC) included IL, IN, IA, MN, NE, ND, SD, and WI.

‡ Northeast (NE) included CT, DE, MD, MA, MI, NH, NJ, NY, OH, PA, RI, VT, and WV.

§ South Central (SC) included AR, KS, LA, MO, OK, and TX.

¶ Southeast (SE) included AL, FL, GA, KY, MS, NC, SC, TN, and VA.

** West (W) included AZ, CA, CO, ID, MT, NV, NM, OR, UT, WA, and WY.

NA = not applicable.

Table 2: Summary of swine veterinarian responses to pen size survey

Survey questions	Responses	Percentiles					Mean
		10th	25th	50th	75th	90th	
1. Are you a veterinarian currently in practice?	Yes (73)	NA	NA	NA	NA	NA	NA
2. No. of production sites serviced by your vet clinic?	73	10	43	150	320	960	326
3. How many of these sites do you personally oversee?	54	5	20	55	150	275	109
4. Do your sow herds use pen gestation? If yes, answer 5-8.	Yes (54)	NA	NA	NA	NA	NA	NA
5. Percent of sow herds that use pen gestation	53	10	23	40	75	100	49
6. Average No. of sows/pen	54	10	15	25	40	88	37
7. Maximum No. of sows/pen	54	20	32	60	100	240	86
8. Minimum No. of sows/pen	54	4	5	10	15	39	16
9. Percent of sow herds that wean into nursery?	72	8	10	50	89	100	48
10. Average No. of weaned pigs/pen in the nursery	72	20	25	30	50	100	107
11. Percent of sow herds that use W-F	64	10	40	70	90	95	62
12. Average No. of weaned pigs/pen in the W-F	64	27	50	75	120	215	94
13. Average No. of pigs/barn in grow-to-finish	72	360	1000	1200	2150	2400	1418
14. Average No. of pens/barn in grow-to-finish	72	11	20	26	40	48	29
Grower-finisher pigs/pen*	72	21	26	50	85	125	82
15. Do you use oral fluid sampling for disease detection?	Yes (73)	NA	NA	NA	NA	NA	NA

* Grower-finisher pigs/pen was calculated by dividing the individual responses of question 13 by question 14.

W-F = wean-to-finish; NA = not applicable.

the shift in infrastructure also impacted disease. Some infections essentially disappeared as a direct consequence of housing pigs in confinement, eg, *Toxoplasma gondii* and *Ascaris suum* infections.[18] However, other infectious agents have thrived in confined swine populations, eg, the agents of the porcine respiratory disease complex.[19] Recognizing that the evolution from outdoor to indoor production had caused a fundamental shift in disease ecology, Schwabe[20] promoted systematic on-farm data collection and analysis as the best approach for understanding the processes impacting livestock health and production. This data-driven approach for understanding causality and evaluating the effects of management decisions on swine health is the basis of today's population medicine.

An important part of population medicine is to understand how production practices affect productivity and health. For example, influenza A virus infections in the small herds of times past were seasonal, with herd immunity rapidly acquired and the infection eliminated. In today's large herds, influenza A virus circulates throughout the year.[21] Similarly, Rotolo et al[22] showed that porcine reproductive and respiratory syndrome virus moves non-uniformly within and between wean-to-finish barns on the same site. Thus, infrastructure impacts disease and disease spread, but there is essentially no information on housing designs currently used by US producers. This study showed that the swine industry, in fact, is still diverse in terms of total inventory and housing design. Interestingly, producers may house from a few to several hundred pigs per pen. Future research should address the impacts of pen and barn inventory on disease ecology and disease surveillance.

Implications

Under the conditions of this study:

- The industry is moving to group housing for gestating sows and larger pens for growing pigs.
- Disease surveillance must fit contemporary production systems.
- All veterinary respondents reported using oral fluids for surveillance.

Table 3: Number and proportion of US swine farms within inventory classification based on US Department of Agriculture Census of Agriculture data

Farm inventory	No, (%) of farms and pigs by year [12-15]							
	2017		2007		1997		1987	
	Farms	Pigs	Farms	Pigs	Farms	Pigs	Farms	Pigs
1-24	46,475 (70.0)	278,691 (0.4)	45,047 (59.7)	260,154 (0.4)	56,092 (44.9)	381,729 (0.6)	86,621 (35.6)	743,251 (1.4)
25-49	3759 (5.7)	122,915 (0.2)	4292 (5.7)	146,672 (0.2)	9411 (7.5)	325,329 (0.5)	26,895 (11.0)	939,637 (1.8)
50-99	1889 (2.8)	122,090 (0.2)	3182 (4.2)	215,206 (0.3)	9334 (7.5)	639,493 (1.1)	29,881 (12.3)	2,058,524 (3.9)
100-199	1220 (1.8)	160,882 (0.2)	2590 (3.4)	354,203 (0.5)	10,364 (8.3)	1,417,039 (2.3)	32,293 (13.3)	4,426,492 (8.5)
200-499	1451 (2.2)	454,960 (0.6)	4524 (6.0)	1,467,383 (2.2)	16,539 (13.2)	5,194,768 (8.5)	40,156 (16.5)	12,334,432 (23.6)
500-999	1305 (2.0)	905,123 (1.3)	3588 (4.8)	2,488,234 (3.7)	10,378 (8.3)	7,104,689 (11.6)	17,878 (7.3)	11,924,290 (22.8)
1000-1999	2016 (3.0)	2,741,382 (3.8)	4013 (5.3)	5,527,798 (8.2)	6597 (5.3)	8,794,666 (14.4)	6865 (2.8)	8,870,231 (17.0)
2000-4999	4724 (7.1)	14,893,679 (20.6)	5356 (7.1)	16,532,918 (24.4)	4323 (3.5)	12,752,495 (20.8)	2403 (1.0)	6,733,228 (12.9)
≥ 5000	3600 (5.4)	52,701,285 (72.8)	2850 (3.8)	40,793,750 (60.2)	1851 (1.5)	24,577,941 (40.2)	406 (0.2)	4,241,035 (8.1)
TOTAL	**66,439**	**72,381,007**	**75,442**	**67,786,318**	**124,889**	**61,188,149**	**243,398**	**52,271,120**

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Conflict of interest

None reported.

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References

*1. Zeder MA. Domestication and early agriculture in the Mediterranean Basin: Origins, diffusion, and impact. *Proc Natl Acad Sci USA*. 2008;105(33):11597-11604. **https://doi.org/10.1073/pnas.0801317105**

2. Zeder MA. The origins of agriculture in the Near East. *Curr Anthropol*. 2011;52(S4):221-235. **https://doi.org/10.1086/659307**

3. Jørgensen D. Pigs and pollards: Medieval insights for UK wood pasture restoration. *Sustainability* 2013;5(2):387-399. **https://doi.org/10.3390/su5020387**

4. Miller ER, Ullrey DE. The pig as a model for human nutrition. *Annu Rev Nutr*. 1987;7:361-382. **https://doi.org/10.1146/annurev.nu.07.070187.002045**

*5. *Hog cholera and its eradication: A review of the US experience*. Animal and Plant Health Inspection Service, US Dept of Agriculture; 1981.

*6. Granger S, Scott K. *Historic context study of Minnesota farms, 1820-1960.* Minnesota Department of Transportation; 2005.

7. Shaw EB. Swine industry of Denmark. *Econ Geogr*. 1938;14(1):23-37. **https://doi.org/10.2307/141556**

8. Spencer S. *The Pig: Breeding, Rearing, and Marketing*. CA Pearson, Ltd; 1919.

*9. *Plans of farm buildings for Northeastern States*. US Dept of Agriculture; 1951. Miscellaneous Publication No. 278. Accessed February 20, 2023 **https://handle.nal.usda.gov/10113/CAT87209187**

10. Harris DL. *Multi-site pig production*. John Wiley & Sons; 2008.

11. R Core Team. R: A language and environment for statistical computing. R Foundation for Statistical Computing; 2024. Accessed March 4, 2024 **https://www.R-project.org**

*12. *2017 Census of Agriculture. United States Summary and State Data. Volume 1. Geographic area series. Part 51*. National Agriculture Statistics Service, US Dept of Agriculture; 2019. AC-17-A-51. Accessed January 10, 2023. **https://www.nass.usda.gov/Publications/AgCensus/2017**

*13. *2012 Census of Agriculture. United States Summary and State Data. Volume 1. Geographic area series. Part 51*. National Agriculture Statistics Service, US Dept of Agriculture; 2012. AC-12-A-51. Accessed January 10, 2023. **https://agcensus.library.cornell.edu/census_parts/2012-united-states**

*14. *2002 Census of Agriculture. United States Summary and State Data. Volume 1. Geographic area series. Part 51.* National Agriculture Statistics Service, US Dept of Agriculture; 2002. AC-02-A-51. Accessed January 10, 2023. **https://agcensus.library.cornell.edu/census_parts/2002-united-states**

*15. *1992 Census of Agriculture. United States Summary and State Data. Volume 1. Geographic area series. Part 51.* National Agriculture Statistics Service, US Dept of Agriculture; 1992. AC92-A-51. Accessed January 10, 2023. **https://agcensus.library.cornell.edu/census_parts/1992-united-states**

*16. Davis CG, Dimitri C, Nehring R, Collins LA, Haley M, Ha K, Gillespie J. *US Hog Production: Rising Output and Changing Trends in Productivity Growth*. Economic Research Service, US Dept of Agriculture; 2022. ERR-308.

*17. Putman B, Hickman J, Bandekar P, Matlock M, Thoma G. *A Retrospective Assessment of US Pork Productions: 1960 to 2015*. University of Arkansas Resiliency Center; 2018. Accessed February 15, 2023 **https://scholarworks.uark.edu/rescentfs/2**

18. Gardner IA, Willeberg P, Mousing J. Empirical and theoretical evidence for herd size as a risk factor for swine diseases. *Anim Health Res Rev.* 2002;3(1):43-55. **https://doi.org/10.1079/AHRR200239**

19. Opriessnig T, Giménez-Lirola LG, Halbur PG. Polymicrobial respiratory disease in pigs. *Anim Health Res Rev.* 2011;12(2):133-148. **https://doi.org/10.1017/S1466252311000120**

20. Schwabe C. The current epidemiological revolution in veterinary medicine. Part I. *Prev Vet Med*. 1982;1(1):5-15. **https://doi.org/10.1016/0167-5877(82)90003-4**

21. Baudon E, Peyre M, Peiris M, Cowling BJ. Epidemiological features of influenza circulation in swine populations: A systematic review and meta-analysis. *PloS one* 2017;12(6):e0179044. **https://doi.org/10.1371/journal.pone.0179044**

22. Rotolo ML, Sun Y, Wang C, Giménez-Lirola L, Baum DH, Gauger PC, Harmon KM, Hoogland M, Main R, Zimmerman JJ. Sampling guidelines for oral fluid-based surveys of group-housed animals. *Vet Microbiol.* 2017;209:20-29. **https://doi.org/10.1016/j.vetmic.2017.02.004**

* Non-refereed references.

Conversion tables

Weights and measures conversions

Common (US)	Metric	To convert	Multiply by
1 oz	28.35 g	oz to g	28.35
1 lb (16 oz)	0.45 kg	lb to kg	0.45
2.2 lb	1 kg	kg to lb	2.2
1 in	2.54 cm	in to cm	2.54
0.39 in	1 cm	cm to in	0.39
1 ft (12 in)	0.3 m	ft to m	0.3
3.28 ft	1 m	m to ft	3.28
1 mi	1.6 km	mi to km	1.6
0.62 mi	1 km	km to mi	0.62
1 in^2	6.45 cm^2	in^2 to cm^2	6.45
0.16 in^2	1 cm^2	cm^2 to in^2	0.16
1 ft^2	0.09 m^2	ft^2 to m^2	0.09
10.76 ft^2	1 m^2	m^2 to ft^2	10.8
1 ft^3	0.03 m^3	ft^3 to m^3	0.03
35.3 ft^3	1 m^3	m^3 to ft^3	35.3
1 gal (128 fl oz)	3.8 L	gal to L	3.8
0.26 gal	1 L	L to gal	0.26
1 qt (32 fl oz)	0.95 L	qt to L	0.95
1.06 qt	1 L	L to qt	1.06

Temperature equivalents (approx)

°F	°C
32	0
50	10.0
60	15.5
61	16.1
65	18.3
70	21.1
75	23.8
80	26.6
82	27.7
85	29.4
90	32.2
102	38.8
103	39.4
104	40.0
105	40.5
106	41.1
212	100.0

°F = (°C × 9/5) + 32

°C = (°F - 32) × 5/9

Conversion calculator available at: amamanualofstyle.com/page/si-conversion-calculator

Conversion chart, kg to lb (approx)

Pig size	Lb	Kg
Birth	3.3-4.4	1.5-2.0
Weaning	7.7	3.5
	11	5
	22	10
Nursery	33	15
	44	20
	55	25
	66	30
Grower	99	45
	110	50
	132	60
Finisher	198	90
	220	100
	231	105
	242	110
	253	115
Mature sow or boar	300	136
	661	300
	794	360
	800	363

1 tonne = 1000 kg
1 ppm = 0.0001% = 1 mg/kg = 1 g/tonne
1 ppm = 1 mg/L