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Growth Performance, Meat Quality and Visceral Organ Evaluation of Swine Raised In Confinement and Free-Ranged Systems

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ABSTRACT

The study was conducted within ninety days duration from May 7-August 7, 2013. It aimed to determine whether the rearing system (either confinement or free – ranged) can affect the growth performance, meat quality and visceral organ characteristics of swine. Twelve (12) heads of swine used in the study which was randomly distributed into two treatments assigned in confinement and free-range

systems, respectively adopting the T-test as the statistical tool. The initial weights of swine were homogenous at the start of the study. However, after obtaining the gain in weights, results revealed that swine raised in the free-range system had a higher average weight and heavier stomach compared to the confinement system. It further revealed that the back fat of the free ranged swine is thinner compared to the swine in confinement system with 1.3 cm and 2 cm, respectively. The total feed consumed by the twelve heads of experimental animals were 2,714 kilograms for 90 days period with 13.73 % return on capital for free – ranged while 5.5 % for confinement. The overall return on capital of the entire experiment was 9.6 %. Therefore, the free-range system had significantly affected the growth performance of swine.

Keywords — Animal Science, meat quality, experimental design, Tampilisan Zamboanga Del Norte, Philippines

INTRODUCTION

In Asian countries like Cambodia, Laos, Philippines, and Vietnam; animal production particularly pig production, has been accorded due importance because of consumers' demand and its expected contribution to the world meat production (Swine Information Network, 2010). Pig production shares 2.0% to 2.8% of the total value of national GDP (Swine Information Network, 2010). In the Philippines, however, the swine industry is the second largest contributor to the country's agriculture coming in next to rice. The 2010 preliminary data show that the country's total swine inventory is estimated at 13.4 million heads (Industry Status, 2000).

As commonly practiced, swine are continuously confined to limited space for economic and health reasons, resulting in the production of considerable quantities of meat (Juska, Juskiene, & Leikus, 2012).

However, a noticeable change from conventional or indoor, to alternative housing system which is raising them outdoor (Gentry, 2001) has been introduced, observed and even practiced by some swine raisers. These are due to a number of considerations such as swine are given enough space and fresh air which can reduce infection pressure (Sather, Jones, Schaefer, Colyn, & Robertson, 1997). Outdoor pig production offers animals' increased environmental diversity and behavioral freedom (Edwards, 2005). Well-designed housing systems for livestock minimize their stress levels and are important from the viewpoint of animal welfare (Yonezawa et al., 2012).

Considering the contradicting results of different studies, the researchers are interested in conducting the study to determine the growth performance, meat quality and evaluation of visceral organs of swine are reared separately under confine and free-range rearing systems.

OBJECTIVES OF THE STUDY

This study was conducted to determine the growth performance, meat quality and evaluation of visceral organs of swine when they are raised in confinement and free-ranged rearing system. Specifically, it aimed to: 1) Determine the growth performance, meat quality, visceral organs and the return on capital (ROC) of swine raised in confinement and free-range systems.

METHODOLOGY

Research Design

The study employed experimental research. All the data gathered were analyzed following the procedure of T-test as a statistical tool.

Research Site

The study was conducted from May 7, 2013, to August 7, 2013, at a privately owned piggery house of Mr. Mario N. Baquiller situated at Barangay 2, Znac, Tampilisan, Zamboanga del Norte, the Philippines with a duration of ninety (90) days. It is within the vicinity of Jose Rizal Memorial State University -Tampilisan Campus (JRMSU-TC), ZNAC Tampilisan Zamboanga Del Norte. The Shed was constructed inside the area with concrete flooring and six (6) individual feeder and drinker intended for the confinement rearing system. For swine raised under confinement, the researchers constructed an individual pig pen for the six experimental animals having the dimension of 30 inches x 72 inches per pen, with feeder and drinker inside the pen. The pig pens were properly cleaned and disinfected. A land area of nine hundred square meters (900 m^2) fenced with hog wire was thoroughly cleaned intended for the swine raised in free-range rearing system.

Experimental Animals

The study utilized two- month old, large white twelve (12) piglets regardless of sex with almost similar weight, farrowed from a common so that were

randomly distributed into two groups assigned in both free-range and confined rearing systems having six (6) piglets in each group.

Feeding management

The study was conducted within the duration of three (3) months and the experimental animals were two (2) months from time of farrowing. The piglets were confined in the rearing area for one month before they were finally transferred into their respective raising area. Drinking waters for the animals were made available at all times, the pigs were given individual feeding and drinking trough inside the experimental area. The feeding was done on a restricted method by giving the required feed ration of the pig daily and dividing it into two sessions -7 o'clock in the morning and 5 o'clock in the afternoon. In the first month of study, pigs were given point five (.5) kilogram or about 2.5% to 3% of its body weight of grower commercial feed per piglet per day and the amount was increased by two hundred fifty (250) grams per week. The same procedure was done up to two months. In the third month of the study, the experimental animals were given two point five (2.5) kilograms or around 4% of animal's body weight of finisher commercial feed per head daily until the study was terminated. The environmental temperature as recorded has a heat index which ranges from 26°C to 27°C at noontime throughout the conduct of the study under weather condition of ZNAC Tampilisan, Zamboanga del Norte, Philippines.

Data Collection

The initial weight of experimental animals was taken at the very start of the study. After which, weekly weighing is conducted to obtain weekly weight. The gain in weight (GW) was determined by subtracting the final weight with the initial weight of the swine. The average daily gain in weight (ADGW) was computed by dividing the gain in weight by the total number of days of the study. The feed Conversion ratio (FCR) was taken by dividing the total feed consumed by the gain in weight.

After the termination of the study, representative swine were randomly selected from each treatment and the same was slaughtered for the evaluation of visceral organ and meat quality as designed in the study. The large and small intestine were measured using a ruler, whereas the heart, gallbladder, liver and the pancreas were also weighed using 10 kilograms with 100 grams precision weighing scale to get its weight. The weight of the stomach was determined by weighing it with fill and without fill. The back fat thickness was also measured in

terms of the unit of a centimeter (cm). The sliced meat was roasted individually for 45 minutes with the required temperature ranging from 100 to 120^{0}C. The slices of meat were placed in a coded plate for the evaluation of the testing panel. The evaluators were composed of ten (10) persons. They evaluate the odor, texture, taste, tenderness and overall acceptability of the meat using appropriate instruments using 9 points hedonic scale.

RESULTS AND DISCUSSION

Table 1. Summary Table of the Average Initial Weight, Weight at 30 and 60 Days, Final Weight, Feed Consumption and Feed Conversion Ratio of Swine Raised In Confinement and Free-Ranged Systems.

Treatment	Initial Weight (kg)	Weight in days (kg)		Final Weight 90 days (kg)	Gain in Weight (kg)	Daily Gain in Weight (kg)	Feed Consumption	Feed conversion ratio (kg)
		30	60					
T_1 (confinement)	18.78	44.17	75.67	104.33	85.55	0.95	226.23	2.64
T_2 (free – range)	18.28	45.17	76.50	111.17	92.88	1.03	226.23	2.43

The experimental swine raised in free-range obtained a higher average gain in weight which was 92.88 kg compared from that of swine raised in confinement which had an average gain in weight of 85.55 kg. Treated statistically, the result showed a significant difference between the two treatments which implies that the kind of rearing system significantly affected the gain in weight of experimental swine after the entire duration of study has been undertaken.

This result is being affirmed by Hansen, Claudi-Magnussen, Jensen, and Andersen (2006), who claimed that alternative reared swine had a higher percentage of lean meat and wholesale carcass value than pork from a confinement system. This is attributed to space allowance and another mineral that are present in soil (Danielsen, Hansen, Møller, Bejerholm, & Nielsen, 2000). Gentry (2001) in his study revealed that outdoor – housed swine grew faster than indoor-housed swine. Similar claimed is presented by Lebret, Meunier-Salaun, Foury, Mormède, Dransfield, and Dourmad (2006) stating that compared with the conventional, the outdoor pigs exhibited a greater growth rate (+10%, $P < 0.001$) due to their greater feed intake (+0.23 kg/d, $P < 0.01$), resulting in a greater body weight at slaughter (+7 kg, $P < 0.001$).

Table 2. Actual Itemize Expenses (US$)

Items	Treatment T_1 (confinement)	Treatment T_2 (free-range)	Entire Expenses
A. Cost of piglets	297.50	297.50	595.00
B. Cost of feeds			
Starter	107.76	107.76	215.52
Grower – 1	137.60	137.60	275.2
Grower – 2	251.01	251.01	502.02
Finisher	215.18	215.18	430.36
C. Veterinary medicine			
Dewormer	2.40	2.40	4.80
Vitamins	2.42	2.42	4.84
D. Electric bill	5.95	3.96	9.91
E. Rental	9.92	5.95	15.87
F. Labor	9.92	7.93	17.85
G. Water	5.95	3.96	9.91
H. Transportation	8.92	9.02	17.94
I. Slaughtering/Butchering	3.96	3.96	7.92
TOTAL	US$ 1,058.49	US$1,048.64	GT =US$ 2,107.14

Table 2 reflects the itemized expenses between the confinements and free – ranged rearing system of swine, the latter had lesser expenses amounted to US$ 1,048.64 compared to those that were raised in confinement with US$ 1,058.49, having the total expenses of US$ 2,107.14 for the entire experiment.

Table 3. Actual Cost and Return Analysis of Swine Raised Under Confinement and Free-Ranged System

Items	Treatment T_1 (confinement)	Treatment T_2 (free – range)	Total
Total no. of swine	6	6	12
Gross income			
Sales of hogs (US$)	1,117.41	1,190.60	2,308.01
Total expenses (US$)	1,058.58	1,046.88	2,105.46
Net income (US$)	58.83	144.72	203.55
Return on capital (ROC)	5.56%	13.82%	9.7%

Based on the price at US$1.73/kg of live weight of swine.

Table 3. Reflects the return on capital (ROC) between the confinements and free – ranged rearing system of swine, the latter had a higher net income amounted to US$144.72 compared to those that were raised in confinement with only US$ 58.83. The Return on Capital (ROC) for free ranged is higher with 13.82% from that of confinement with only 5.56%.

Table 4. Summary of the Weight of Stomach, Liver, Gallbladder, Pancreas, Lungs, Heart, and the Length of the Small Intestines and Large Intestine of Swine Raised under Confinement and Free-Range Rearing Systems

Type of rearing system	Weight in (g)						Length (cm)	
	Stomach	Liver	Gall-bladder	Pancreas	Lungs	Heart	Small intestine	Large intestine
Confinement	1,100	1,850	50	200	500	400	1,563	621
Free – ranged	2,200	1,700	50	200	650	350	1,707	507

Table 4 is the summary table for visceral organ evaluated during slaughtering of the two swine chosen as representative for both confined and free-ranged rearing systems.

As reflected, there is a slight difference in their figures specifically for stomach, liver lungs, heart, small intestine, and large intestine.

Table 5. Summary Table of the Dressing Percentage and Back Fat Thickness of Slaughtered Swine Raised In Free-Ranged and Confinement Systems

Parameters	Treatment		Mean
	Confinement	Free – range	
Dressing percentage (%)	70.48	69.17	± 1.31 69.825
Back fat thickness (cm)	2	1.3	± 0.7 1.65

Table 5 reflects the dressing percentage and back fat thickness of slaughtered swine raised in free-ranged and confinement systems. Figuratively, the back fat thickness of hogs raised in free-range is lesser with .7 cm which means that it has a better meat quality.

Table 6. Summary of the Odor, Taste, Tenderness, Texture and Overall Acceptability of Meat of Slaughtered Swine Raised In Free – Range and Confinement Systems

Type of rearing system	Odor		Taste		Tenderness		Texture		Overall Acceptability	
	NR	DR	NR	DR	NR	DR	NR	DR	NR	DR
Confinement	3.95	Moderately Desirable	3.73	Moderately Desirable	3.60	Tender/ 15-31	3.60	Moderately Rigid	3.94	Moderately Acceptable
Free – ranged	3.96	Moderately Desirable	3.85	Moderately Desirable	3.88	Tender/ 15-31	3.78	Moderately Rigid	4.19	Moderately Acceptable

Legend:
NR – Numerical Rating
DR – Descriptive Rating

Table 6 is the summary table for meat quality of slaughtered swine raised both in confinement (T_1) and free-ranged ($T_{2)}$ rearing systems. As reflected, the odor, taste, texture and overall acceptability of the meat both confined and free ranged are rated similarly as moderately acceptable and tender. This means that the meat quality of the two swine is the same regardless of how swine is being raised, may it be confined or free-range.

These findings were in consonant to the study of Stern, Heyer, Andersson, Rydhmer, and Lundström (2003) and Hansen, Claudi-Magnussen, Jensen, and Andersen (2006) stating among others that meat quality of swine was not affected by the kind of rearing system. The same was supported by Dransfield et al. (2005) who mentioned that there was no difference in the taste of grilled pork from indoor and outdoor production systems.

Hence, the growth performance of swine raised in free-range system is numerically heavier than those that were raised in confinement implying therein that the kind of rearing system has a significant effect to the growth performance of swine (Juska, Juskiene, & Leikus, 2013; Hansen, Claudi-Magnussen, Jensen, & Andersen, 2006, & Gentry, 2001). The meat quality of hogs was not significantly affected by the kind of rearing system as well as the visceral organ, (Stern, Heyer, Andersson, Rydhmer, and Lundström, 2003) Swine raised in free-range has a heavier gain in weight than those that are confined (Juska, Juskiene, & Leikus, 2013; Hansen, Claudi-Magnussen, Jensen, & Andersen, 2006; Stern, Heyer, Andersson, Rydhmer, and Lundström, 2003) The return on capital (ROC) of free-ranged swine is higher with 13.82% than confined swine with only 5.56%.

CONCLUSIONS

The result of the study revealed that the rearing system either confinement or free – range system did not significantly affect both the visceral organ and meat quality of swine. Nonetheless, for the growth performance, results showed that pigs which are raised under free-range obtained a heavier gain in weight compared those that were raised in confinement. Although the result is not alarming but based on the findings of the study, free-range rearing system is recommended in raising of swine. However, the free-range system demands a big space or area which eventually a factor to consider since areas are limited. Further, another research shall be conducted using the same rearing systems but with a bigger number of experimental animals to find out if similar results will yield.

TRANSLATIONAL RESEARCH

The findings of the study may be best translated to different reading materials such as pamphlets, brochures or flyers for information dissemination so that animal raisers who are in remote areas can have the access on the information. It could also be articulated as part of extension activities of the academe for awareness campaign or technology transfer.

LITERATURE CITED

Danielsen, V., Hansen, L. L., Møller, F., Bejerholm, C., & Nielsen, S. (2000). Production results and sensory meat quality of pigs fed different amounts of concentrate and ad lib. clover grass or clover grass silage. In *Ecological animal husbandry in the nordic countries* (Vol. 2, pp. 79-86). Danish Research Centre for Organic Farming: Tjele, Denmark. Retrieved from https://goo.gl/HusVkd

Dransfield, E., Ngapo, T. M., Nielsen, N. A., Bredahl, L., Sjödén, P. O., Magnusson, M., ... & Nute, G. R. (2005). Consumer choice and suggested price for pork as influenced by its appearance, taste and information concerning the country of origin and organic pig production. *Meat Science*, *69*(1), 61-70. Retrieved from https://doi.org/10.1016/j.meatsci.2004.06.006.

Edwards, S. A. (2005). Product quality attributes associated with outdoor pig production. *Livestock Production Science*, *94*(1-2), 5-14. Retrieved from https://doi.org/10.1016/j.livprodsci.2004.11.028

Gentry, J. G. (2001). *Alternative and outdoor housing systems for pigs: effects on growth, meat quality, and muscle characteristics* (Doctoral dissertation, Texas Tech University). Retrieved from http://hdl.handle.net/2346/20776

Hansen, L. L., Claudi-Magnussen, C., Jensen, S. K., & Andersen, H. J. (2006). Effect of organic pig production systems on performance and meat quality. *Meat Science*, *74*(4), 605-615. Retrieved from https://doi.org/10.1016/j.meatsci.2006.02.014

Industry Status-PCAARRD. (2000). Retrieved from www.pcaarrd.dost.gov.ph/home/momentum/swine

Juska, R., Juskiene, V., & Leikus, R. (2013). The influence of a free-range housing system on pig growth, carcass composition and meat quality. *Journal of applied animal research*, *41*(1), 39-47. Retrieved from https://doi.org/10.1080/09712119.2012.738215

Lebret, B., Meunier-Salaun, M. C., Foury, A., Mormède, P., Dransfield, E., & Dourmad, J. Y. (2006). Influence of rearing conditions on performance, behavioral, and physiological responses of pigs to preslaughter handling, carcass traits, and meat quality. *Journal of Animal Science*, *84*(9), 2436-2447. Retrieved from https://doi.org/10.2527/jas.2005-689

Sather, A. P., Jones, S. D. M., Schaefer, A. L., Colyn, J., & Robertson, W. M. (1997). Feedlot performance, carcass composition and meat quality of free-range reared pigs. *Canadian Journal of Animal Science*, *77*(2), 225-232. Retrieved from https://doi.org/10.4141/A96-093

Stern, S., Heyer, A., Andersson, H. K., Rydhmer, L., & Lundström, K. (2003). Production results and technological meat quality for pigs in indoor and outdoor rearing systems. *Acta Agric Scand (A)*, *53*(4), 166-174. Retrieved from https://bit.ly/2W4HIiH

Swine Information Network (2010) DOST-PCAARRD Portal. Retrieved from www.pcaarrd.dost.gov.ph

Yonezawa, T., Takahashi, A., Imai, S., Okitsu, A., Komiyama, S., Irimajiri, M., ... & Hodate, K. (2012). Effects of outdoor housing of piglets on behavior, stress reaction and meat characteristics. *Asian-Australasian journal of animal sciences*, *25*(6), 886. Retrieved from doi: 10.5713/ajas.2011.11380